The Engineer

LONDON, FRIDAY, APRIL 4, 1941.

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R. O. HARRIS,
County Architect.

Park Street,
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25th March, 1941. 7302

PATENTS AND DESIGNS ACTS, 1907 to 1939

Notice is Hereby Given that Houdaille-Hershey Corporation, of 2188, National Bank Building, City of Detroit, State of Michigan, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 526,966, granted to them for an invention entitled "Improvements in or relating to Methods of Electro-buffing Nickel."

Particulars of the proposed amendment were set forth in No. 2723 of the Official Journal (Patents), published on April 2nd, 1941.

Any person, or persons, may give NOTICE of OPPOSITION to the AMENDMENT by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.

M. F. LINDLEY,
7312 Comptroller-General.

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IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

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The Engineer

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PAPER ECONOMY

It has now become necessary, in order to maintain the normal circulation of THE ENGINEER, to print all advertisement pages on the Thin Paper hitherto used for the Foreign Edition.

So long as our diminishing stocks of thick paper will allow, the Home Edition Editorial pages will be printed on the usual paper, so that uniformity in bound volumes may be maintained.

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Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

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THE PROPRIETOR of BRITISH PATENT No. 439,510, dated June 8th, 1934, relating to "Improvements in a Localising Control Device in Machines for Continuously Feeding Sheet Material," is DESIROUS of ENTERING into ARRANGEMENTS by WAY of a licence or otherwise on reasonable terms for the purpose of EXPLOITING the above Patent and ensuring its practical working in Great Britain.—Inquiries to SINGER, EHLERT, STERN and CARLBERG, Steger Building, Chicago, Illinois. 7256 H

THE PROPRIETOR of the Following BRITISH PATENT DESIRES to NEGOTIATE with interested parties with a view toward EXPLOITING this INVENTION, on reasonable terms, in Great Britain :—

No. 405,440, "Improvements in and relating to Cutter Tools of the Insertable Blade Type."

For particulars kindly address ALBERT F. NATHAN, Patent Counsel, Professional Building, Plainfield, New Jersey, U.S.A. P3202 H

THE PROPRIETORS of BRITISH PATENT No. 491,673, for "Improvements relating to Manganese Steel," are DESIROUS of ENTERING into NEGOTIATIONS with firms in this country for the EXPLOITATION of the above INVENTION, either by the SALE of the PATENT RIGHTS or by the GRANT of LICENCES to MANUFACTURE on royalty.—Inquiries should be addressed to ABEL & IMRAY, Quality House, Quality Court, Chancery Lane, W.C.2. 7301 H

THE PROPRIETOR of BRITISH PATENT No. 476,781, dated June 16th, 1936, relating to "Apparatus for Producing Diamond Boring Bits or the like," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Inquiries to SINGER, EHLERT, STERN and CARLBERG, Steger Building, Chicago, Illinois. 7307 H

For continuation of Small Advertisements see page 68

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The Engineer
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Canals in Wartime

SPEAKING at the recent annual luncheon of the Mansion House Association on Transport, at which the chair was taken by the President, Mr. Isodore Salmon, Lieut.-Colonel J. T. C. Moore-Brabazon, the Minister of Transport, referred to the general position at the ports, which, he said, was getting better every day. Looking back only a few months, it could be easily noticed what a great improvement in the port position had taken place. On the subject of canals Lieut.-Colonel Moore-Brabazon promised that the fullest possible use would be made of that type of water-borne transport. It was, he said, interesting to see how the railway companies had treated the canals, and how road interests had treated the railways. In the future it might easily happen that air transport interests would treat the road interests in the same way. Such considerations could, he thought, only lead to the one conclusion, that while in many industries competition might be healthy and good, in transport it was neither. The railway companies, he said, had done, and were doing, some remarkably good work, but it seemed likely that there would have to be some concentrated planning during the summer months. . . . . In a Journal note of February 21st we recorded the decision of the Minister of Transport to appoint Mr. Frank Pick to investigate and report upon the carriage of traffic upon canals and inland waterways; also the plea of Sir William Prescott, the Chairman of the Lee Conservancy Board, for the maintenance and upkeep of our canal systems, and the provision of the necessary labour for working the barges.

The Replacement of Merchant Ships

IN his speech at the annual general meeting of the Lamport and Holt Line, Ltd., which was held in London on Thursday, March 27th, Sir Philip Haldin, the chairman of the company, said that the company's fleet of ships was now fully requisitioned by the Government and there was little to say regarding it. The two new motorships ordered in 1939 had both been delivered and their returns, together with those of the free voyages of the fleet prior to requisition, were reflected in the increased total net profits for the year of £187,392. Of that amount the sum of £40,000 was placed to the depreciation account, a dividend of 6 per cent. was recommended, and the balance was carried forward. Sir Philip said that the pleasure of his annual report to the shareholders was marred by the knowledge that their fleet had suffered losses, and that the amount recoverable under the war risk insurance scheme, together with the company's reserves, would be insufficient to replace the vessels lost at the prices now ruling. The depreciation allowance of 5 per cent. was quite inadequate as things were to-day. On this miserable allowance ships would have to plough the sea for about forty years before sufficient funds could be accumulated to replace them at to-day's prices. The Government had promised to maintain the mercantile marine in adequate strength, but Sir Philip thought that one of the first steps to take to ensure prompt replacement would be to let the shipowners purchase the ships which had been built or were now building to the order of the Ministry of Shipping. Another difficult matter was the unsympathetic attitude of the Ministry in connection with the abnormal circumstances and expenditure involved in the running of ships under war conditions. He contended that the British mercantile marine, which, having been recognised at long last as the most vital service to ensure the salvation of the country, should be treated with generosity. It must always be remembered that at the outbreak of war the British shipping industry was able to put at the disposal of the nation some 20,000,000 tons of shipping, vital to the winning of the war to which our energies were bent.

Wartime Labour Problems

AT a conference which was held at Montagu House, Whitehall, on Monday, March 31st, the Ministry of Labour and National Service presented a statement on some of the current problems of the supply and utilisation of labour in the war industries. The conference was attended by representatives of the technical Press and the institutions, and a short discussion took place. At the present time, it was stated, there is a definite scarcity of both machine tools and skilled labour. The Ministry of Labour Inspectorate was in a position, it was stated, to give broad advice on the setting up of work and the replanning of production lay-out with the object of saving tools and labour. At the present time there is practically no reserve left of skilled and tool-room labour, and this lack of men is being met by schemes for the dilution, upgrading of skilled labour, and the "de-skilling" of operations. In de-skilling, it was explained, it is sought to cut out all unnecessary skilled operations, so as to ensure that the time of highly skilled men is never used on operations which require less than the best level of performance of these men. The Ministry suggests that these principles of conservation of labour can be applied to a greater degree than most employers have yet realised. Attention to the possibility of subdividing operations will, it is claimed, be generally rewarded. Thus a series of operations may be broken up and graded, some requiring higher skill than the rest. The use of the most highly skilled labour should be confined, it is suggested, to the more difficult operations. The remainder may be divided amongst workers at various stages in their training. Such analysis is especially important in machining operations. In the tool-room it has been found that the principles of division and specialisation can be applied with excellent results. Men of all-round experience can to some degree be replaced by specialists in certain processes, and other men may be skilled enough to carry through one or two operations if the work is planned with a view to enable each man to play his part. Some employers have found it useful to train some of the best apprentices for tool-room work. In the Government training centres much is being done to train skilled, semi-skilled, and demi-semi-skilled workers; but this latter category of workers must, it is pointed out, be produced by employers who train workers for their own requirements. In some cases there has been effective co-operation between the training centres and firms, and training courses have been adapted to special needs. The statement points out that enough use is not being made of the available woman labour, which it has been shown can be effectively employed on ranges of work as far apart as marine propelling machinery and fine limit gauge work. Finally, the Ministry suggests that the problem of labour and machine tools will be greatly helped by forward planning so that the output of all official training schemes can be controlled and adapted to the maturing needs of industry.

Delay in Building Aerodromes

IN a report from the Select Committee on National Expenditure, which has just been published by the Stationery Office, criticism is made of the delay in the construction of aerodromes. In the report it is stated that some contracts for the construction of aerodromes are already many months behind schedule. At a station which was recently visited by the Sub-Committee on Air Services, it was found that this station, which it had been hoped to bring into partial operation by the end of last year, would not be completed for another six months. On this particular work only 500 men were employed, whereas 1000 were needed, and there was, in addition, a great shortage of lorries. The report urges that the Air Ministry should consider the adoption of a policy of strict priority in aerodrome construction. Contractors, the Committee urges, should be encouraged to make greater use of sub-contractors, and the Air Ministry should help contractors to obtain release of maintenance fitters and materials for the repair of transport. The Government Departments concerned, it is stated, should try to organise area pools of labour, transport, and materials required for aerodrome construction. All contractors, it is further suggested, should be informed of the latest improved methods of construction, and all ideas and information should be pooled. A consulting panel of civil engineers to advise Government Departments on the placing of work and contract conditions should be appointed. The Committee reports that final costs in general prove much higher than the estimates, and it urges that the Ministry should return at once to the practice of letting fixed price contracts wherever practicable. Where target cost contracts are employed, efficient supervision is essential. The Committee is inclined to believe that in requisitioning land the Ministry does not always treat owners, occupiers, and local residents with sufficient consideration.

The War Damage Commission

LAST week the first meeting of the War Damage Commission was held at the London headquarters of the Commission at Devonshire House. As announced by the Chancellor of the Exchequer in the House of Commons, the names of the members of the Commission are as follows:—Mr. A. M. Trustram Eve, K.C., Chairman; Mr. Joseph Hallsworth, Secretary-General of the National Union of Distributive and Allied Workers; Mr. Alexander Macdonald, general manager of the Royal Exchange Assurance; Mr. Charles Mackintosh, Sheriff of Argyle; Mr. John Morrison, of Thomson, McLintock and Co., chartered accountants; Mr. L. G. Vigers, chartered surveyor, and President of the Parliamentary Committee of the Chartered Surveyors' Institute; and Mr. William E. Whyte, a member of the Scottish Housing Committees. The Secretary of the Commission is Mr. F. P. Robinson. At the opening meeting Mr. Trustram Eve, discussing the work of the Commission, said that sympathy, simplicity, and speed would be its guiding principles. A regional office would be established at the headquarters of each Civil Defence Region. In London, because of its size, there would be four offices. The addresses of these and the districts they covered would be made public as soon as they were ready to open. Managements and staffs had been selected, and the higher officials in each region had been assembled in London for an intensive course of training in every branch of their work. Headquarters at Devonshire House, he said, would be reserved for advice on doubtful cases, for dealing with cases of special classes of property, and for seeing that claimants throughout the United Kingdom were treated with uniformity and with equal speed. Policy would emanate from headquarters, but the day-to-day work of the Commission would be done in the regional offices.

Engineering Firms and Excess Profits Tax

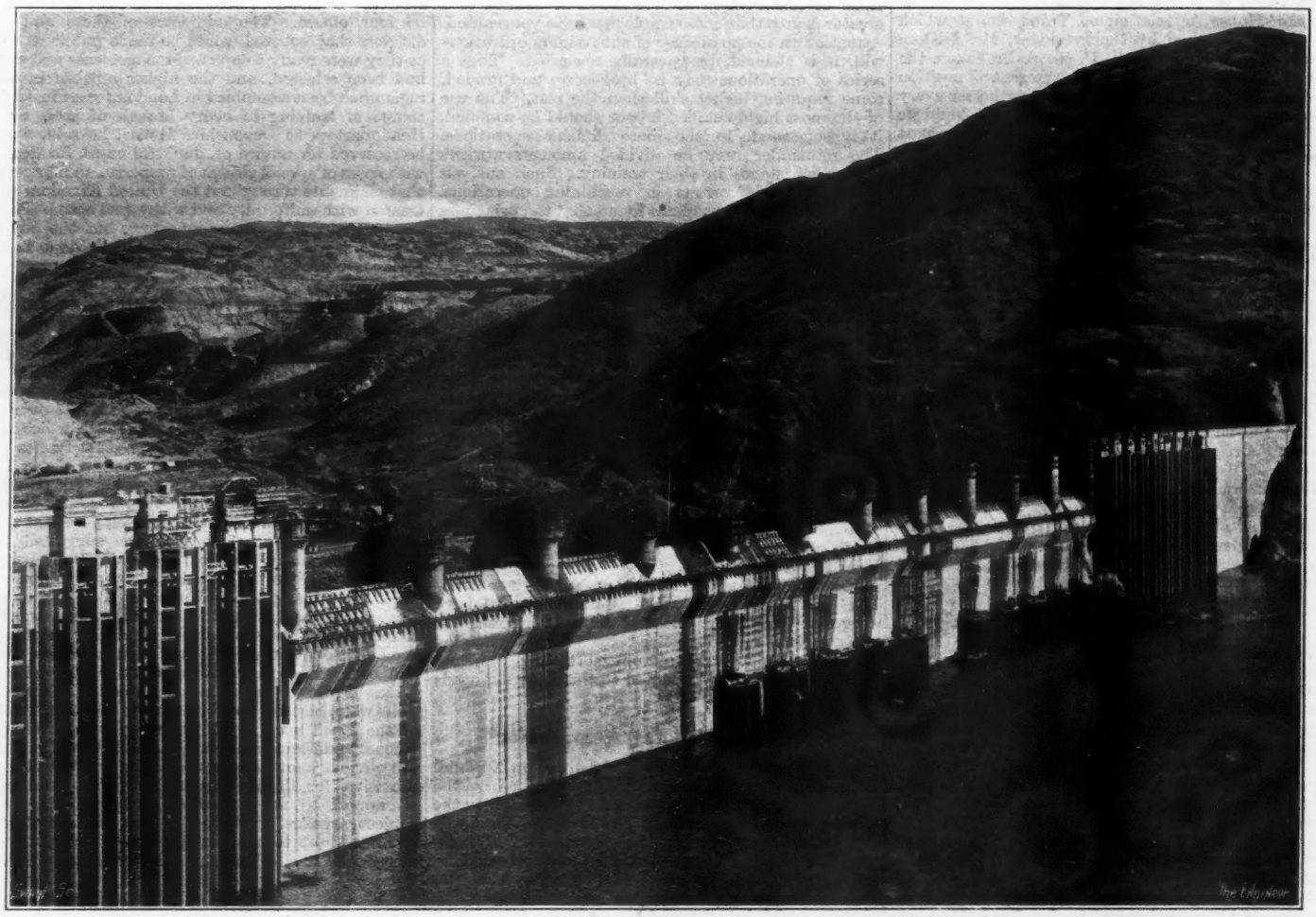
SPEAKING at the fifty-third annual general meeting of Hadfields, Ltd., which took place on Monday, March 31st, Mr. P. B. Brown, M. Inst. C.E., the chairman and managing director of the company, said that there was an increase of £267,835 over the provision for taxation made in 1939, which was mainly due to the higher rates of Excess Profits Tax and the Income Tax, and the arrears of tax, the liability for which had not been agreed. The payment of taxes to-day, Mr. Brown said, presented a difficult problem for many companies. He felt sure that those present agreed with him when he suggested that where a company such as Hadfields, Ltd., had to bear the burden of financing large volumes of work in progress and stocks in connection with Government contracts, it was somewhat unreasonable to expect it at the same time to find very substantial sums of money to meet its taxation liability. Much had been said and written about the 100 per cent. Excess Profits Tax, as it now stood. Representations were, he said, now being made to the Chancellor of the Exchequer which he hoped would result in amendments being made to the Act that would remove the obvious anomalies now existing and would make provision for dealing equitably with special cases on appeal to the Board of Referees. The same subject was referred to by Sir Bernard Docker in his address to the eighty-seventh annual general meeting of the Birmingham Railway and Carriage Company, Ltd., which was held in Birmingham on Tuesday, April 1st. Sir Bernard said that he did not think his claim to be treated as what was termed a "depressed industry" during the period of the war would be disputed. He regarded it as of the greatest importance in the national interest that the Excess Profits Tax regulations should be amended so that companies might be able to make vitally necessary provision for the future.

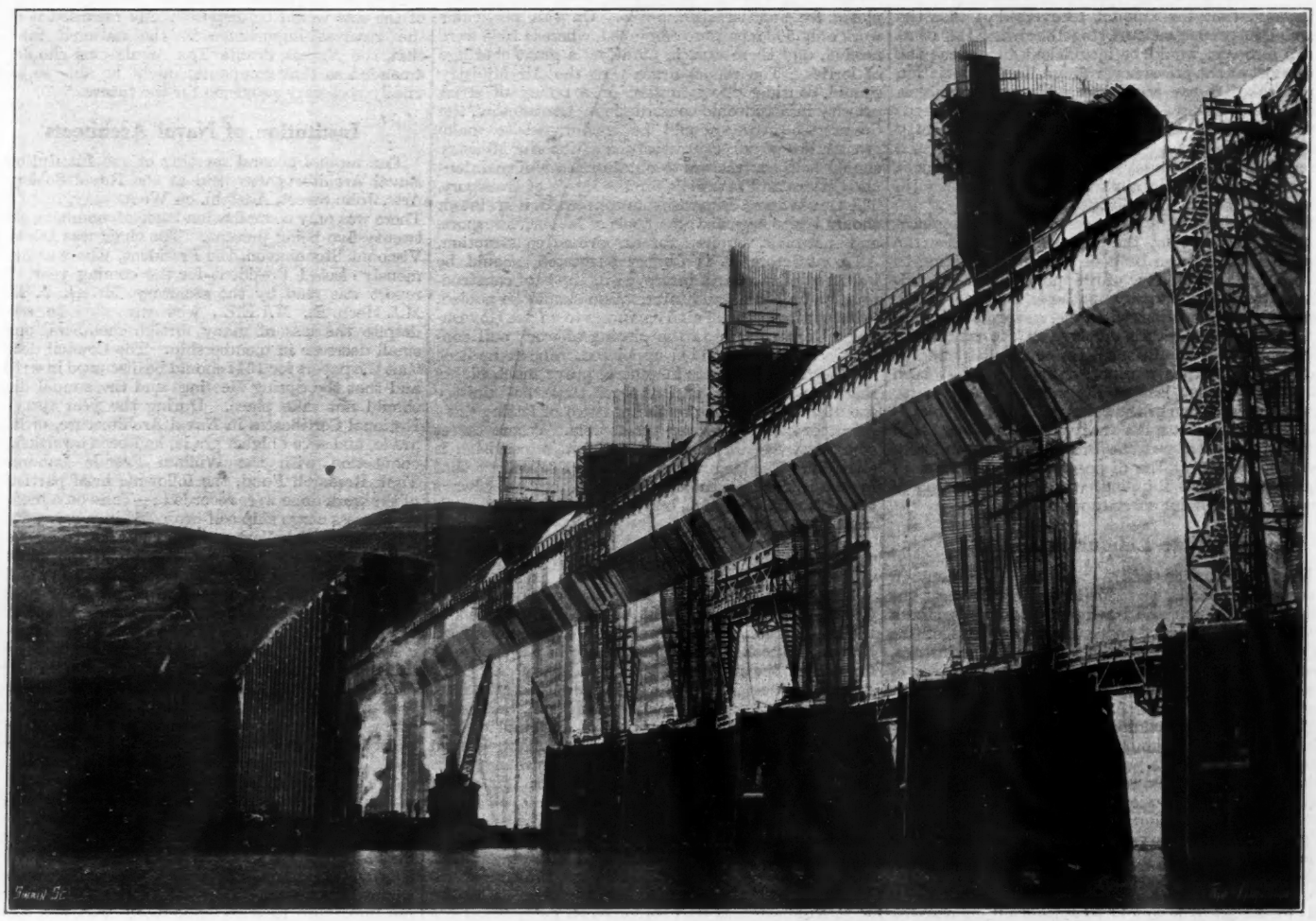
Institution of Naval Architects

THE annual general meeting of the Institution of Naval Architects was held at the Royal Society of Arts, John Street, Adelphi, on Wednesday, April 2nd. There was only a small attendance of members, about twenty-five being present. The chair was taken by Viscount Stonehaven, the President, who was unanimously elected President for the coming year. The report was read by the secretary, Mr. G. V. Boys, M.I. Mech. E., M.I.E.E., who was able to report, despite the loss of many foreign members, only a small decrease in membership. The Council decided that the papers for 1941 should be discussed in writing, and that the Spring Meetings and the annual dinner should not take place. During the year forty-five National Certificates in Naval Architecture, ordinary grade, and seven higher grade, had been awarded. In connection with the William Froude Laboratory Tank Research Fund, the following brief particulars of the work done were recorded:—Tests on a model of an express cargo ship self-propelled in rough water in both load and ballast condition, to determine power and sea behaviour; determination of the effect on a twin-screw ship of varying the shaft supports from brackets to solid bossings and of propeller position relative to the surface; the experiments on the shape of bow contour in relation to entrance water-line character have been concluded; experiments to determine the vibration patterns and frequencies of propeller blades have been commenced; the series of tests on models of coasters, and on low-pitch ratio screws have been continued; a new series of model resistance tests in which the beam will be varied in two different ways will be initiated as soon as circumstances permit; owing to war conditions, the researches on steering, vibration, and fouling of ships and several other subjects have been discontinued for the time being. In the unavoidable absence of Sir Philip Devitt, the accounts were presented by Sir Eustace Tennyson d'Eyncourt, the acting treasurer, who reported that the accounts showed a satisfactory position. Sir Eustace announced that the sum of £2000 had been bequeathed to the Institution by the late assistant secretary, Mr. Arthur Dansie.

GRAND COULEE DAM, U.S.A.

(For description see opposite page)





UPSTREAM VIEWS OF DAM FROM EASTERN AND WESTERN SIDES OF CANYON

Grand Coulee Dam

No. II

(*Continued from page 208, March 28th*)

THE outlet tunnels or conduits through the dam are arranged in pairs in three tiers, 100ft. apart vertically—the lowest tier being at El. 934. On the upstream face of the dam, each vertical line of these twin tunnels is protected by a semi-circular trashrack structure that has a radius of 22ft. and a height of 250ft., so as to guard the intakes of six tunnels on the three levels. Close to the intake portal of each of the conduits are installed two gates in tandem, with a short section of conduit between. From the upstream face of the dam to a point 12ft. downstream from the downstream gates, each conduit is lined with heavily ribbed, semi-steel castings, 1⅜in. in thickness and 8½ft. in diameter. The lining is bell-mouthed at the intake to promote a smooth flow of the water and prevent cavitation. The gate bodies are also heavily ribbed semi-steel castings, 1⅜in. thick. The gates are designed to operate at a maximum head of 250ft., and with the water surface in the reservoir at El. 1184—high level—the maximum discharge with all of the outlet gates opened will be 265,000 second-feet. At greater reservoir elevations the lower gates will be closed, and then the two upper tiers of the outlet conduits will discharge a maximum of 210,000 second-feet when the surface of the reservoir is at its full elevation, 1288ft.

Downstream from the cast steel linings of the conduits at El. 934, they are unlined, but heavily reinforced and descend through the concrete mass of the dam in a parabolic curve which issues from the downstream face of the dam on a tangent to the curve of the bucket section of the spillway. The conduits on the two higher levels are lined downstream from their gates with welded plate steel, ⅜in. in thickness. These conduits pierce the dam horizontally, but, near the downstream face, they turn sharply downward and emerge almost parallel to the downstream face of the spillway.

Two gates are installed in the outlet conduits. The upstream gate is operated by oil pressure that acts on a piston, 13½in. in diameter. Besides permitting inspection of the downstream gate it can serve in an emergency if the other gate became inoperable. The downstream gate, in each case, is the regular service gate. It is raised and lowered by a hoist mechanism consisting of two motor-driven screws.

Immediately above each installation of the two pairs of gates there is a gate chamber that houses the operating equipment and provides room for maintenance and repairs. The gate chambers of each tier of conduits are connected in series by galleries that extend the length of the dam.

Installing the gates and the tunnel linings entailed the handling and placing of heavy weights. For example, each pair of gates at the lower line weighed 367,000 lb., and the conduit linings for each tunnel weighed 148,500 lb. The combined weights in the two upper lines of conduits were somewhat less, but still very heavy. The gates had to be installed soon enough to avoid high stages of the river, and the contractor had to move rapidly and to co-ordinate his work so that the short time available would suffice. This was necessary especially when the spillway was in the course of upbuilding, and the desire was to control the volume of water still flowing over the dam through the open channels or slots that were to be filled successively with concrete.

During the construction of the spillway section the structural blocks were dealt with in two groups which differed 15ft. in elevation. Ordinarily, the river passed through the group having the lower elevation, but as the pouring of the concrete progressed the low blocks were closed off with the closure gates already described. By closing off the lower blocks to permit filling them with concrete, the temporary blocking of the river raised the level of the stream and caused the water to flow through the next higher group. In this manner the flow of the river was diverted from side to side of the spillway, and the water rose an additional 15ft. with each unit rise of the spillway. The contractor, when placing the closure gates to pour the concrete blocks of the spillway, was required to lower a closure gate so deliberately that the water level downstream from the dam should not drop more than 18in. in twenty-four hours. The result was that at certain stages of the river's flow as much as thirty-six hours passed during the lowering of the closure gates. It was not until after the middle of September, 1939, that the last slot in the spillway was closed against further diversion of the river, and the water surface upstream of the dam at that time was at El. 1024. The available outlet tunnels sufficed to handle the water and to maintain the upstream level where desired.

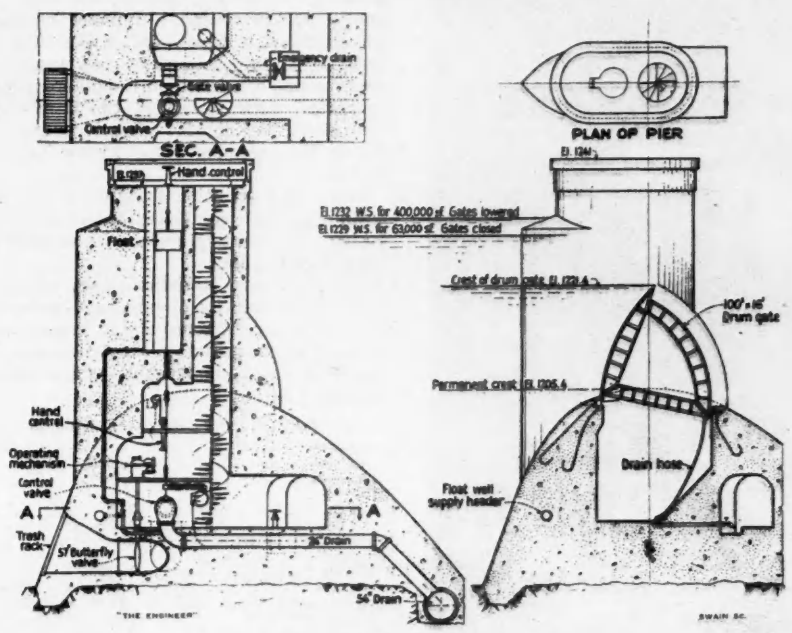
At the present time the spillway of the Grand Coulee dam is finished, and its eleven drum gates have been installed. Each drum gate is 28ft. high and 135ft. long. When the gates are raised to their full height, they increase the capacity of the pool or reservoir upstream of the dam by 32 per cent. The drum gate, such as has been adopted by the Bureau of Reclamation, is hinged on castings that are anchored along the upstream side of a recess in the spillway crest, and when a gate rests in that recess the upstream face of the gate lies flush with the crest of the concrete weir structure and subscribes to the curve of the crest. The operating principle is that of buoyancy. The gate is floated to an upright position by water pressure within the recess beneath the gate, and, oppositely, the gate is lowered by relieving the pressure. Close regulation can be exercised through means provided for hand, automatic, or remote control.

The drum gates on the Grand Coulee dam are much like the drum gates on the weir of the Boulder dam spillways, and the following description and accompanying line drawing of those drum gates explain also the drum gates on the spillway of the Grand Coulee dam. Automatic control by a float mechanism or independent hand control is provided for operating each gate. A float is mounted in a well in each pier. The lower end of a rod attached to the float supports a sheave through which passes a cable attached at one end to a pilot valve inside the main control valve, with a 24in. differential needle valve which controls the flow of water from the gate recess. The pilot valve, actuated by the rise or fall of the float, controls the movement of the main body of the control valve. The other end of the cable, after being carried through a second sheave, is attached to a quadrant which, in turn, is affixed to and turns with the end hinge pin of the drum gate so that upward movement of the gate exerts a pull on the cable coupled to the pilot valve. The result of this combination is to open the control valve when the float rises. On the escape of water from the gate recess the gate will lower, unwinding cable from the quadrant, allowing the control valve to close. The quadrant therefore effects a counter-acting or restoring action in the control mechanism, causing the gate to come to rest when the reservoir becomes stationary.

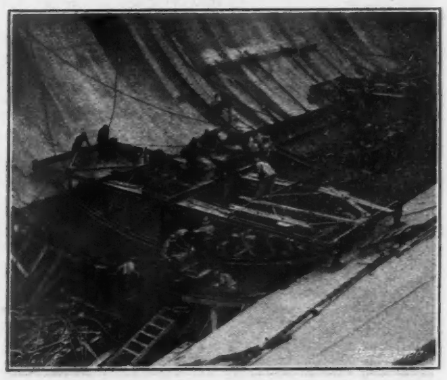
From a position on top of the pier a hoist may be used to raise or lower the float. From another position in the pier beneath the sheave assembly a mechanism may be used to adjust the position of the lower sheave. The manipulation of either has the same effect as a change of reservoir water. An emergency drain extending from the gate recess to an outlet downstream from the spillway weir, normally closed by a gate valve, may be operated by hand to control the gate should the hand-control mechanism or automatic apparatus be out of order.

Flow into the gate recess is provided by a 58in. diameter pipe connecting the recess with the reservoir. A butterfly valve controls the amount of water passing to the recess. As the rising reservoir level reaches the inlet the recess chamber fills, floating the gate up in advance of the rising water surface. When the gate reaches its maximum position, the water against the bottom holds it in position until an additional rise in the reservoir, operating through the control mechanism, opens the control valve and releases water from the chamber, allowing the gate to lower. This additional rise may be selected at will. At Boulder dam it is intended that the reservoir water surface will be about 7·5ft. above the crest of the gate, corresponding to the discharge of 63,000 second-feet for both spillways. With a slight rise above this elevation the gates will lower completely, after which an additional rise of approximately 3·5ft. will discharge the total capacity of 400,000 second-feet. As the flood peak decreases the gates automatically rise to their maximum position, and remain there until the flood discharge has ceased. As the water surface level recedes, the gates automatically return to their lowered position.

Seals are particularly important in connection with automatic control because it is desirable to prevent, as nearly as possible, any leakage from the gate chamber. Spring brass seals are used at the upstream edge of the gate along the hinge casting, at both ends and along the downstream gate seat. Any accumulation of water inside the



DRUM GATES OF BOULDER DAM



PLACING CONCRETE AT TOE OF DAM

gates is drained by a flexible hose at each end of each gate, coupled at one end to the gates by ball-and-socket joints and connected at the other end to pipe drains.

Because the thermometer drops as much as 20 deg. below zero in winter time in the canyon where the Grand Coulee dam stands, suitable provision has had to be made to defrost the gates, so that they will not become inoperable through icing. Defrosters are being installed at each end of each gate, and where a gate rests on its steel seating when lowered. This installation is made up of more than 9 miles of electric heating cable, and approximately an acre of steel plates. The plates will be heated by induction, a comparatively new method of electric heating for this purpose. The largest of the eleven plates will be 135ft. long by 8·5ft. wide, and there will be twenty-two pier plates, one at each end of each gate, which will have an area of about 875 square feet each.

As will be recalled, the description of the Grand Coulee dam published by us during February of 1938, mentioned that there would be two power houses, one on each side of the river on the downstream slope of the dam. Under the present contract only the western power house has been built, while the east power house is represented only by its finished foundation. The west power house is now in process of being partly equipped, and will not have all nine of its designed generators installed until there shall be a sufficient demand for their output. All told, ultimately, there will be eighteen of the big generators in service in the two power houses. At this time, contracts have been awarded for the installing of three major units, each of which will have a capacity of 108,000 kVA and three station service units, each having a capacity of 12,500 kVA. Each of the large generators will be connected to a bank of three 36,000 kVA transformers by means of the bus structure already ordered. These various features of the power plant equipment will be in place and ready for service during the current year. What power may be developed in excess of local needs will be transmitted over the power line which now connects the Grand Coulee dam site with the Bonneville dam, which is supplying electric energy to a steadily increasing market in the states of Washington and Oregon. Each of the main generators will be driven by a vertical hydraulic turbine of 150,000 H.P., and water for each turbine will be delivered to it through a penstock, 18ft. in diameter. A coaster gate, with a hoist, is installed at the entrance of each of the penstocks for the three units that will go into service this year. The penstock coaster gates act as guards, to be closed in emergencies in case of damage to the hydraulic turbines, or whenever it may be necessary to unwater the penstocks to permit inspection and maintenance of the penstocks and turbines. Normally, the gates will be opened and closed under conditions of balanced hydrostatic pressure on opposite sides of the gate leaves, and with no flow through the penstocks, but under emergency conditions the gates may be closed when subjected to an unbalanced hydrostatic head of 245ft. on the upstream side of the gate leaves and with unrestricted flow through the penstocks. The coaster gates are to be operated by hydraulic hoists, using oil as a medium, with a maximum working pressure of 1000 lb. per square inch in the hoist cylinders.

On the west side of the reservoir and adjoining the dam abutment has been constructed the pumping plant, which is to contain twelve pumps, each driven by a direct connected motor of 65,000 H.P. The rating of each pump is 1600 cubic feet a second. The pumps will operate against heads that will range from a normal of 295ft. to a maximum of 367ft., and the water will be lifted to the canal leading to the Grand Coulee balancing reservoir through discharge pipes 10ft. diameter, and which have a length of approximately 700ft. The greatest demand for pumping will come during the two months of each year when the river is at its high stage, that is, June and July. The storage capacity of the reservoir above the dam will be 10,000,000 acre-feet of water when at the highest impounding level. The upper 80ft. then will represent a volume of 5,000,000 acre-feet, and that water will be available for power generation and for regulating the flow of the river downstream. Part of the secondary power generated will be used during high-water seasons to pump water into the Grand Coulee balancing reservoir for irrigating purposes. The maximum flow at the dam site is 492,000 cubic feet a second, while the minimum flow is about 20,000 cubic feet a second. The average flow the year round is 109,000 cubic feet a second, and it is said that two months of average flow will be sufficient to fill the reservoir.

The average amount of electrical energy that may be available each year is estimated at 12,520 million kilowatt-hours, of which 8320 million kilowatt-hours will be firm energy and 4200 million kilowatt-hours will be secondary energy. A maximum of 2260 million kilowatt-hours of this secondary energy will be used for pumping water for irrigation use. The turbines that will supply power for local use and for sale are of the Francis type with single vertical runners, and with respect to their horse-power capacity they are the largest hydraulic prime movers so far built. The centre lines of the turbine distributors are set at El. 938, so that the tail water surfaces will vary from about 60ft. above to 6ft. below the centre line of the turbines—the average being from 5ft. to 10ft. above it. The turbines will operate under a net effective head that will vary from a minimum of 265ft. to a maximum of 355ft., but for 90 per cent. of the time the weighted average net head will be 330ft. The power house has been constructed of reinforced concrete, with steel trusses. The downstream wall is of box girder design and heavily reinforced so as to be able to withstand the pressure of tail water up to a possible maximum elevation at flood stage, that is, El. 1020.

The plans of the Army engineers contemplate ten dams on the Columbia River between the Canadian border and the mouth of the stream, and so make it possible to utilise 92 per cent. of the fall of the Columbia within the United States. The Grand Coulee dam will account for 27 per cent. of the total head. By controlling the flow of the Columbia, the Grand Coulee dam will double the firm power of plants between it and the mouth of the Snake River, and will increase by 50 per cent. the firm power output of other plants below that point, including that at the Bonneville dam. Release of stored water will maintain low water levels in the lower river 2ft. higher than those of of the uncontrolled river, and so provide a deeper navigable channel and reduce the dredging required.

When the mixing and placing of concrete were resumed this spring, only about 35,000 cubic yards of concrete remained to be placed to bring the dam to completion. The concrete work includes the elevator towers, sidewalks, spillway bridge, parapets, and a number of minor but miscellaneous features. After the shut down of concrete pouring because of cold weather, steady progress was continued on the different operations connected with installing the dam's electrical equipment, which is extensive, and in preparing the pumping plant to receive its initial pumps.

When the irrigation features of the Columbia basin project are completed, then the entire undertaking will have required an expenditure totalling 384,000,000 dollars.

The following statistical data of the Grand Coulee dam and its appurtenant features should be of value for reference and in helping to a ready grasp of the magnitude of the structure and what it represents as a remarkable engineering accomplishment :—

WORK IN PROGRESS AT NIGHT

The Dam ; Ultimate Dimensions and Ratings.

Length—	
At base	3,000ft.
At crest	4,300ft.
Width—	
At crest	30ft.
At base	500ft.
Height above lowest bedrock	550ft.
Spillway—	
Width	1,650ft.
Capacity	1,000,000 second-feet
Spillway gates	11·28ft. high, 135ft. long
Outlet tunnels (60)	Diameter 8½ft.
Concrete content	11,250,000 cubic yards
Cement content	12,000,000 barrels
Reinforcing steel, power houses, &c.	77,000,000 lb.
Steel sheet piling	19,000 tons
Timber, all purposes	100,000,000 board-feet
Excavation for the dam—	
Common	Nearly 20,535,422 cubic yards
Rock	Over 2,095,557 cubic yards
Excavation for sand and gravel (ultimate)	About 25,000,000 cubic yards
Main excavation conveyor—	
Width	60in.
Length	About 7,000ft.
Maximum output per day (twenty-one hours)	50,839 cubic yards

The Power Plant

Power plant capacity	1,981,500 kW
Turbines (18)	Each rated at 150,000 H.P.
Generators (18)	Each rated at 108,000 kVA

The Storage Reservoir

Area	82,000 acres
Length	151 miles
Capacity—	
Total	10,000,000 acre-feet
Useful	5,000,000 acre-feet
Pumps (12, 2 spares), capacity, each	1,600 cubic feet per second
Average pumping head	280ft.
Pump motor rating	65,000 H.P.

Columbia River Basin Above Coulee Dam

Area	74,100 square miles
Mean annual run-off above dam	79,000,000 acre-feet
Maximum required for irrigation	6,000,000 acre-feet
Mean annual flow	109,000 second-feet
Maximum recorded flow	492,000 second-feet

The next major stage in the Columbia basin project will be the building of the dams that will transform the length of the Grand Coulee into a reservoir that will be filled with water pumped into it from the pool above the Grand Coulee dam. This part of the project, as well as the distributing canals for irrigating the lands of the Columbia basin, is still to a considerable extent in the planning stage, but will be taken in hand in the near future.

Air Force Targets in Germany

No. XIX

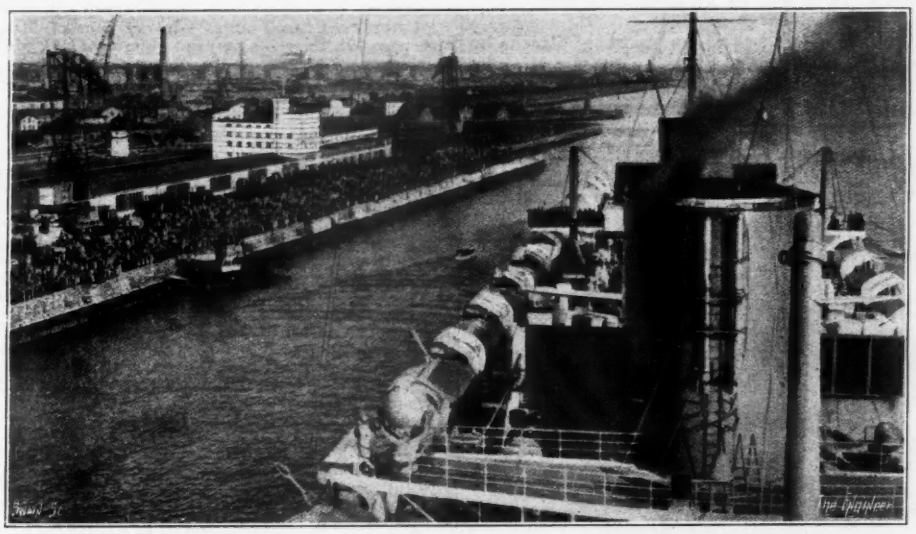
(*Continued from page 180, March 14th*)

BREMERHAVEN AND THE NORTH GERMAN SEAPORTS

DURING the past few weeks some of the main attacks delivered by the Royal Air Force Bomber Command have been directed against the northern ports and naval bases of Germany. The accompanying sketch map shows the relative positions of these targets, along with their principal interconnecting railways, canals and rivers. In our last article we dealt more especially with the

MAP OF NORTHERN GERMAN SEA PORTS

Hansa city of Bremen, and described its system of docks and the many industries for which it is famed. As mentioned in that article, not less important than Bremen itself is the outer port of Bremerhaven, which is situated on the right bank of the River Weser, about 32 nautical miles from its mouth. Bremerhaven, together with Wesermünde, forms a town of about 100,000 inhabitants, and it now includes the districts and former townships of Geestemünde, at the mouth of the River Geeste, and the Lehe district.



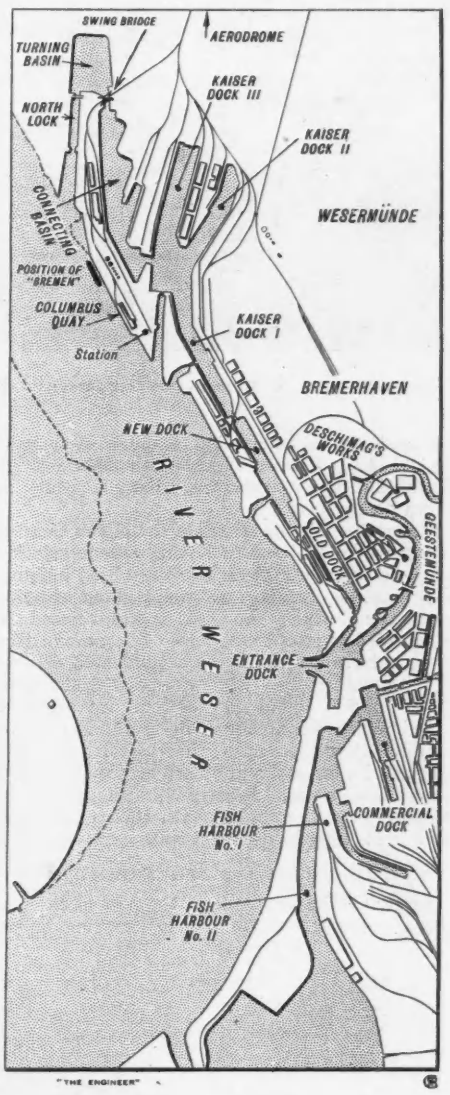
VIEW OF COLUMBUS QUAY AND MARINE STATION

THE PORT OF BREMERHAVEN

The port of Bremerhaven has in past years come to be particularly associated with the fast Atlantic passenger service of the Norddeutscher Lloyd Company, which has been principally maintained by the express steamers "Bremen," "Europa" and "Columbus." Our article to-day has more than usual interest, since we are able to include in it an official British photograph showing the position of the burnt-out liner "Bremen" at the end of the Columbus quay. As we recorded in one of our Journal notes of March 21st, it was announced on the German wireless that a serious fire had broken out on the liner on the evening of Sunday, March 16th, and was only put out after nearly two days, during which time it was fought by many fire brigades. After that announcement had been made the exact whereabouts of the ship, then not stated, was revealed by a photograph taken by a reconnaissance aircraft of the Bomber Command, and showing her with smoke still pouring from her bow and stern. The pilot also reported that she appeared to be burnt out amidships. Although it has been stated by German authority that the fire arose from an unknown cause, it is said to have started in several places. In that connection it is perhaps significant that the docks at Bremerhaven were visited by a single aircraft of the Bomber Command on the night of March 13th–14th, when they were attacked as an alternative target.

COLUMBUS QUAY AND THE MARINE STATION

The principal interest of the port lies around the Columbus quay and its Marine Station, and the large dry docks which lie alongside it, which have been provided for the dry docking of the largest liners. The quay itself has a total length of 3000 m., or about 3280ft., and can accommodate two of the world's largest liners independently of the state of the tide, a depth of water for ships up to 40ft. draught being provided. An accompanying engraving is reproduced from a photograph taken from one of the large liners when approaching the quay. It shows the quay itself and some of the discharging devices, which before the war were looked upon as conforming with the most modern practice. When coming alongside the practice was to shoot thin lines from guns on the ship's decks fore and aft, by which the mooring cables were at once drawn ashore and slipped over the bollards. Hardly had the ship touched the quayside than the two M.A.N. level luffing cranes, indicated in the picture, dropped on deck two sets of automatic travelling conveyor belts, which began to transfer hand luggage and trunks to the Customs Hall. Other facilities at the port include commodious waiting-room accommodation, with a large restaurant. Adjoining is the Marine Station, from which fast trains run to Bremen and thence to Hamburg, Berlin, Hanover and other parts of the country. For those who might wish to save still further time, air services used to be available from the nearby Bremerhaven aerodrome, while the swing bridge over the entrance to the turning basin dock carries a road which connects with main roads to the east and south. This bridge is one of the largest of its kind in Northern Germany and we illustrate it in one of our engravings. It was designed and erected by the Maschinenfabrik Augsburg-Nürnberg, of Gustavsburg, near Mainz, and has a total length of 112 m. It carries a double railway track and a carriageway and is of the unequal arm pattern, the respective lengths of the two arms being 78·5 m. and 33·4 m. The electrically operated turning gear is arranged below the shorter arm of the bridge. The centre upon which the bridge turns has a diameter of 1 m. and carries a pinion which engages with a sector arm. The bearing is designed to maintain a total load of 2800 tons. Our map of the port of Bremerhaven is reproduced from the Admiralty Chart No. 3506, by permission of the Hydrographer of the Admiralty. It shows clearly the lay-out of the various docks, many of which are designed as dry docks. This applies in particular to the new Kaiser docks, which have their own dock entrance leading to a turning basin, while the docks are further linked by a connecting basin. The length of Kaiser Dock No. I is 226 m., with a breadth of 30 m. and an available high-water depth of 10·8 m. Kaiser Dock No. II has a length of 335 m., a width of 40 m. and a depth of 11·56 m., and it is this dock which was generally employed for the dry docking of the large liners "Bremen," "Europa" and "Columbus" during periods of overhaul and repair. In addition to these large dry docks there are also in Bremerhaven four other



THE PORT OF BREMERHAVEN

dry docks in private ownership. They vary in length from 43 m. to 168 m. with widths of 13 m. up to 18·5 m., and several of them are designed to accommodate two ships at the same time.

The total area of wet docks in the port of Bremerhaven amounts to over 200 acres, most of the docks being in the Free Port district, which extends over an area of 600 acres. Alongside these docks are sheds and privately owned warehouse accommodation, which are served by a network of railway lines. Further particulars of some of these docks are as follows:—The Connecting Basin has a total length of 1000 m. and its width varies from 100 m. to 120 m., a total water depth of 38ft. at high tide being provided. The crane equipment comprises two 7½-ton electric grab cranes of the travelling type and ten cranes, each with a capacity of 3 tons. There are two sheds at this dock, in addition to a frozen meat storage plant. In the Kaiser Dock No. III, which has a length of 600 m. with a breadth of 150 m., and the same depth of water as the connecting basin, there are three storage sheds, which are served by three 7½-ton travelling grab cranes and twenty travelling cranes with lifting capacities of from 2½ to 3 tons. The Kaiser Dock No. I is

generally used by vessels requiring heavier lifts. It has a length of 1100 m. and is 110 m. in width, while its crane equipment includes a 30-ton hydraulic crane and two 20-ton cranes, one of which is power-operated and the other hand-operated. There is only one shed at this dock. The New Dock, which has a total quay length of 1635 m., is 900 m. in length with a breadth of 100 m., has six sheds and is served by 12½-ton cranes. It can be used by ships needing a draught of 29ft. at high water. Fishing vessels, for which the Wesermünde section of the port is specially equipped, are accommodated on the West Quay of the Old Dock, which also deals with general cargo. In addition there are also two fishing harbours, as shown on our plan.

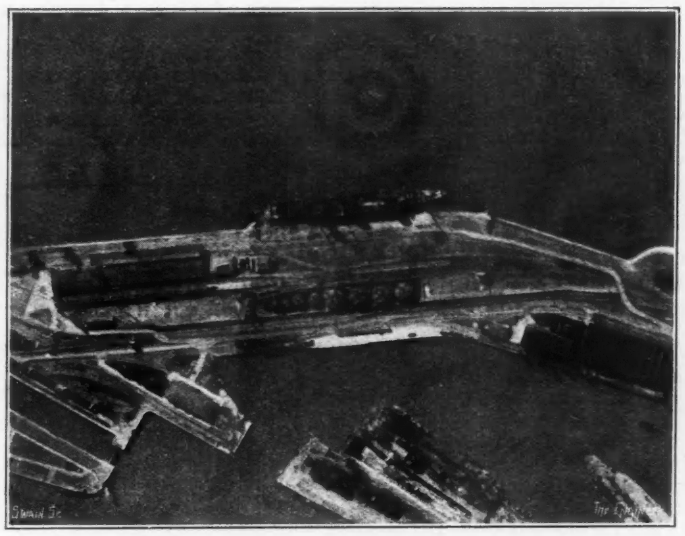
Wesermünde is the centre of the North German fishing trade and besides having accommodation for the docking of vessels there are boat building and repairing yards and well-laid-out auction halls, from which the fish is transported in refrigerated wagons to all parts of Germany. The port we have described has a total area of over 14,220 square metres, while the total shed area is about 104,000 square metres and the privately owned warehouse accommodation 143,000 square metres. At nearly all the principal berths bunkering facilities for coal and oil are provided. In the view of the burning "Bremen" the oil tanks at the Columbus quay, complete with their camouflage paint, will easily be distinguished.

Shipbuilding and Ship Repairing

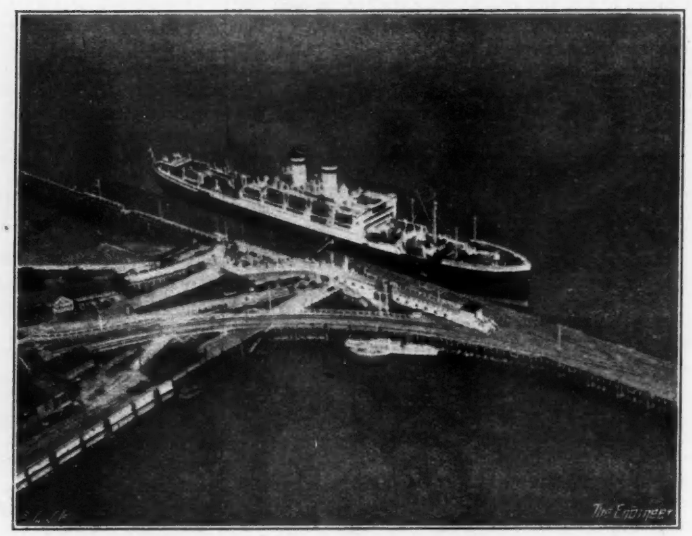
Nearly all the shipyards at the port of Bremerhaven are now part of the undertaking of the Deutsche Schiff-und Maschinenbau A.G., better known as the Deschimag, whose principal yards are at Bremen—see the article on that port—and at the Vulkan Yard at Hamburg. The main shipbuilding yards we are dealing with in this article are in the Wesermünde and Geestemünde districts. In the latter part of the town, within the bend of the River Geeste, is the yard founded in 1842 by Herr Tecklenborg, which after 1897 operated until a few years ago as the Joh. C. Tecklenborg A.G. It has five berths and three patent slips for fishing vessels and it was designed to build passenger and cargo ships, marine steam and oil engines, and boilers, the number of workers employed being about 3000. Another yard in the same area is that founded by the firm of G. Seebeck in 1895. It also was constructed to build passenger and cargo ships, and the firm has specialised in the building of ships for the transport of coal and iron ore. Repairs are also done at this yard, which has its own machine shops for the making of steam marine engines and oil engines. It employs about 2500 workers in the yard and engine works. Other yards in the district include those of the Nordhavener Schiffswerft G.m.b.H., which specialises in the building and repair of small vessels.

Within the last few days it has been reported from credible sources that mines laid by aircraft of the Coastal Command in the Kiel Canal, have greatly reduced the use of that waterway, especially for the larger mercantile and naval ships. It is understood that the sinking of a cargo ship laden with iron ore has reduced the useful width of the canal by about half and has greatly slowed up the canal traffic.

Other attacks have been made on searchlight



Air View of Burnt-Out "Bremen" at Columbus Quay

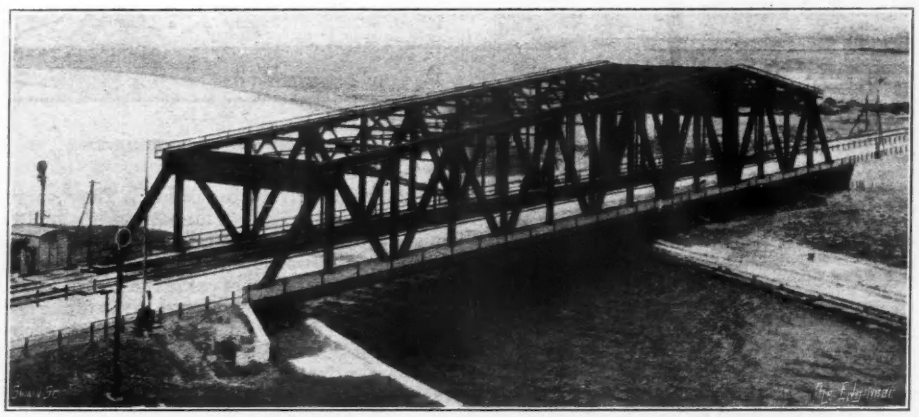


Hamburg-Amerika Liner at Cuxhaven

deutscher Werft m.b.H. at Geestemünde and the Schiffbaugesellschaft Unterweser at Geestemünde-Lehe. Further up the river in the direction of Bremen is the engine works and shipyard of the Bremen Vulkan Schiffbau und Maschinenfabrik at Vegesak, which has a long history going back to the old yard which was founded by Johann Lange in 1817. It is connected with the Thyssen concern and has seven building berths with lengths up to 250 m., besides plating, boiler and machine shops. This yard was the subject of an early attack by the Bomber Command.

Other Ports in Northern Germany

Within the last two weeks reports of attacks by the Bomber Command made by the Air Ministry have referred to further attacks on important shipyards and docks at Hamburg and targets to the north of the Elbe, which, like those at Hamburg, were left burning fiercely. Such targets would no doubt include renewed attacks on the entrance to the Kiel Canal at Brunsbüttelkoog and the important deep sea harbour at Cuxhaven at the mouth of the Elbe, which has been the subject of more than one attack by aircraft of the Bomber Command. In one of our engravings we show one of the fast Hamburg-Amerika liners of the "Deutschland" class calling at the Cuxhaven harbour, which before the war formed the principal landing port for the H.A.P.A.G. passenger service. The general character of this port will be seen from our illustration. Cuxhaven also has its fishing and shipbuilding industries, and the principal firm at the port is the Cux-



Rail and Road Swing Bridge Over Dock Entrance at Bremerhaven

stations and gun emplacements at Oldenburg and on the naval yard and shipbuilding establishments at Emden, Kiel and Wilhelmshaven. For particulars of these targets, including that of Bremen, also again recently attacked, we may refer our readers to the articles already published, which appear in the following issues of The Engineer:—Kiel and the Kiel Canal, July 12th, 1940; Emden and Wilhelmshaven, August 9th, 1940; the port of Hamburg and its shipbuilding industry, December 6th, 1940.

"Epicyclic Gear Trains."—In our issue of March 21st, page 191, there is a misprint in formula (12), which should read:

$$\frac{M_C}{M_A} = \frac{R_e}{E_o} - 1 = \frac{R_o - E_o}{E_o}.$$

The Engineers' Club, Manchester.—Despite the many difficulties which clubs and other similar institutions experienced owing to the cancellation of meetings of the technical societies and the absence of members on active service, the Engineers' Club, Manchester, had a satisfactory year in 1940. The membership showed a substantial increase over that of the previous year, particularly with regard to patron members, but the receipts from these sources were adversely affected by the suspension of subscriptions of members who are on active service. At the annual meeting, held recently, Mr. A. B. Mallinson, M.I. Mech. E., M.I.E.E., was elected President, succeeding Mr. C. D. Taite, M.I.E.E., who retired after holding this office for the maximum permissible period of two years. Mr. E. Royle was re-elected Honorary Treasurer and Mr. H. Richardson, M.I. Mech. E., consented to continue as acting Honorary Secretary.

Institution of Naval Architects.—As recorded elsewhere in this issue, the annual general meeting of the Institution of Naval Architects took place on Wednesday, April 2nd, at 12.30 p.m., in the Lecture Hall of the Royal Society of Arts, John Street, Adelphi, London, W.C.2, when the chair was taken by the President, Lord Stonehaven. Only formal business was transacted and there was no annual dinner. Below we give a list of the papers which have been selected for publication in this year's volume of "Transactions." Applications for advance copies of these papers should be made to the Secretary who will forward them as soon as they are ready for issue. Written comments on the papers are invited with a view to their publication in the "Transactions." The papers chosen are:—No. 1, "Features of Wartime Shipbuilding—Suggested Measures for Speeding-up the Production of Merchant Ships," by Mr. W. Eyre; No. 2, "A Naval Architect's Practical Experiences in the Behaviour of Ships," by Mr. John H. Narbeth, C.B., R.C.N.C. (ret.); No. 3, "Historical Notes on Investigations at the Admiralty Experiment Works, Torquay," by Mr. R. W. L. Gawn, R.C.N.C.; No. 4, "The Effective Wave Slope," by Dr. G. S. Baker and Mr. D. M. Baker; No. 5, "Analysis of Skin Friction," by Mr. F. W. Thorne, B.Sc.; No. 6, "Model Experiments on Twin-screw Propulsion" (Part III), by Dr. G. Hughes, B.Sc.; No. 7, "The Effect of Shape of Bow on Ship Resistance" (Part III), by Mr. A. Emerson, B.Sc.; and No. 8, "Components of Propulsive Efficiency and their Variation," by Mr. A. Kari, M.Sc.

High - Speed Fire Alarm for Detecting Incendiary Bombs

THE use of an automatic warning system will prevent serious fires caused by incendiary bombs if the alarm is given almost immediately after the bomb has ignited. It cannot be too strongly stressed that the efficacy of any fire detecting apparatus for incendiary bombs is directly proportional to its speed of response. A recent memorandum entitled "Fire Detection Devices, with Special Reference to the Detection of Incendiary Bombs," prepared by the Institution of Electrical Engineers, Advisory Committee to the Ministry of Home Security, has strongly stressed this point, and the new British Standard Specification B.S./A.R.P. 53 for the detection of incendiary bomb fires by heat-sensitive devices recognises three forms of automatic fire detection. We describe herewith

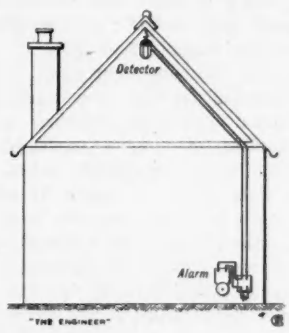


FIG. 1—MOUNTING OF FIRE DETECTOR UNIT

a new system which falls within the third group of this specification, that is to say, one in which "the melting of an alloy interrupts a closed circuit."

The principle of using a low-melting alloy for fire detection is well known, and such units are on the market. Fig. 1 shows how such a detector unit is usually mounted; it is recommended that the detector unit be mounted as high as possible in order to get the effect of the rising hot air caused by a fire. The detector consists of a cage, allowing free passage of the hot air to the actual detecting element, which consists of two metal springs, held together by a low-temperature alloy. If the alloy softens or melts away due to excessive hot air the springs separate, thus interrupting a closed alarm circuit.

This type of unit, although satisfactory in the case of an ordinary fire, is of little use in the case of incendiary bombs, because the time taken for the incendiary bomb burning on the floor to cause the unit to give the alarm is much too great, and a serious fire would result before the alarm would be given. The reason for this is that the heat given off by an incendiary bomb, although intense, is very local, and the effect is often more noticeable below than above.

There are two main points to be considered. First, where to install the high-speed fire detectors; and

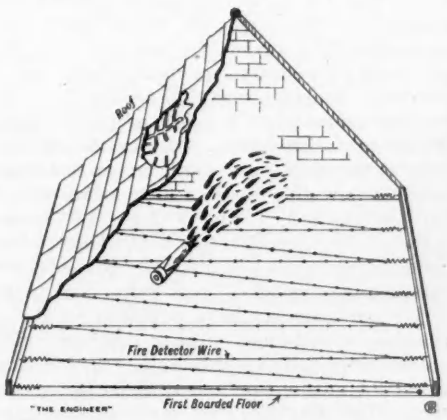


FIG. 2—ARRANGEMENT OF FIRE DETECTOR WIRES

secondly, how to arrange the detector equipment. The findings of the Ministry of Home Security, published in its handbook, "Air Raids," Chapter 3, page 23, are that "the light incendiary bomb has been designed to penetrate any ordinary roof material such as slate or tile, and to become lodged in upper stories, where a fire may result. Unless the bomb enters through a window it will probably be arrested by the *first boarded floor* below the roof, where it will start a fire and then, burning its way through the floor, start a further fire on the floor below." It follows that high-speed fire detectors should be installed on or near the first boarded floor below the roof. This practice is opposed to that used in the past, in which the detectors have always been mounted as high as possible, in order to make use of the hot air stream. The arrangement of the detector equipment should be such that wherever a bomb may lodge on the first boarded floor it will be in close proximity to at least one of the detector units.

The new system, resulting from these conclusions, is shown in Figs. 2 and 3. Fig. 2 shows the first boarded floor with the fire detector wire with low-temperature melting inserts. An incendiary bomb is indicated ejecting a blast of hot fire in a more or less horizontal direction, which is the way in which incendiary bombs usually burn. It will be seen that wherever the bomb falls on this floor one or more fusible inserts will soften or melt immediately, thus interrupting a closed alarm circuit. Even if the blast of the fire does not directly touch one of the fusible inserts, the intense heating of the wire will rapidly conduct the heat to the fusing point.

Fig. 3 shows a sectional elevation of the complete equipment, the fire detector wire being only about an inch above the first boarded floor, whereas the alarm equipment is mounted in the shelter or within easy reach of the fire watchers. As soon as one of the low-temperature inserts melts away the alarm line is broken. It is not necessary that the insert should melt completely away, as it is sufficient if some softening occurs, because the joint will separate

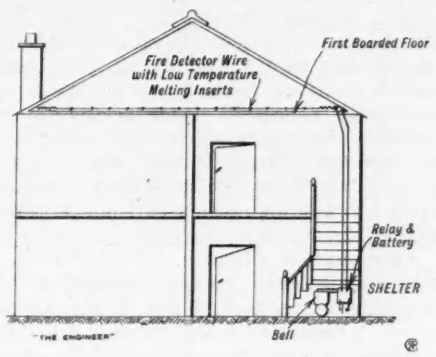


FIG. 3—DIAGRAM OF FIRE DETECTION EQUIPMENT

under these conditions, for the wire is kept under tension by springs. There is a detector insert every foot in the wire, and the distance between two neighbouring wires never exceeds 1ft. Should, therefore, a bomb ignite, the alarm will operate no matter where the bomb may lodge on the first boarded floor. In this connection it should be mentioned that if the wire is broken through a direct hit from a bomb the alarm will be given immediately and that any accidental breakage of the heat detector wire or the connecting wiring will cause an immediate sounding of the alarm, thus calling attention to the fact that the line is broken.

It is essential that during times of war the cost of such protective equipment should be kept as low as possible and that the minimum amount of material should be used in its construction. The construction of this high-speed fire detector wire is claimed to conform with these conditions and it will be seen from the following description of the relay alarm units that these also are in accordance with these conditions. Fig. 4 shows two standard types of

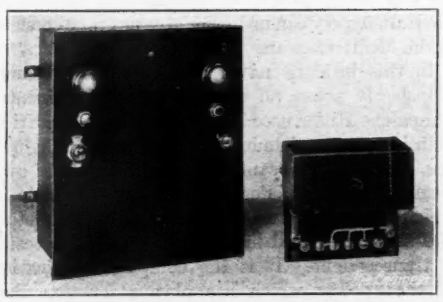


FIG. 4—RELAY ALARM UNITS

"Londex" relay alarm units. The smaller one conforms with the British Standard Specification B.S./A.R.P. 53 and is suitable for battery operation only. The larger pattern can be supplied for all-battery operation or for direct operation from the mains, but with the alarm bell or hooter operated from a small battery This again conforms with British Standard Specification B.S./A.R.P. 53, which calls for the alarm to be battery operated and to give a continuous audible signal if actuated through the relay. The importance of this clause lies in the fact that in the case of direct mains-operated units the alarm should not only be given if the line is broken, but also if the mains supply fails. The use of the mains has the great advantage that current is taken from the battery only under actual alarm conditions. The small current permanently passing through the fire detector loop is taken from the low-voltage side of a small transformer, incorporated in the equipment, and is thus supplied from the mains. This affects a considerable saving in the size and life of the batteries required.

The wiring diagram of the small alarm unit given in Fig. 5 is self-explanatory. The fire detector loop is connected to terminals 3 and 4 and the current passing through this loop energises the coil of a small midget relay, and as long as this current circulates the relay contacts controlling the bell are held open. The relay is arranged for hand resetting after the alarm. A simple "on/off" switch is provided to cut off the equipment when not required, and a similar test switch is provided in order to check the operation of the alarm by simply breaking the loop. The alarm sounds automatically should the battery voltage fall below a certain level, thus calling attention to the fact that the battery must be replaced.

In the larger model, Fig. 6, there is again an

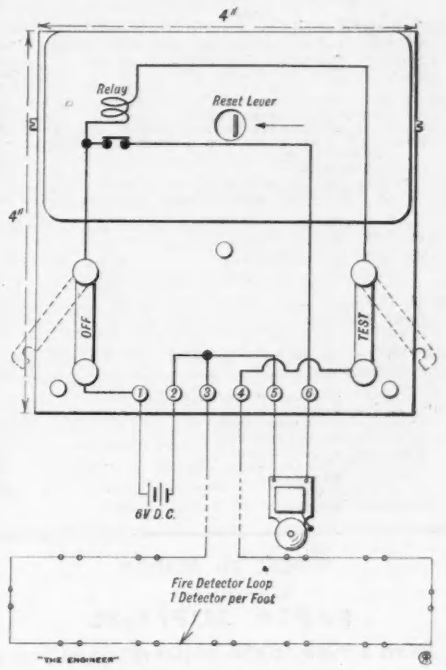


FIG. 5—WIRING DIAGRAM OF ALARM UNIT

"on/off" switch on the left-hand side of the panel, and on the right-hand side an alarm test switch. Red and green indicator lamps are provided, the green being alight under normal conditions, thus indicating that the mains supply is intact; whereas the red light illuminated indicates a break in the loop, *i.e.*, alarm conditions; at the same time the bell or other audible warning device will sound. The sounding of the alarm bell with neither of the signalling lamps illuminated denotes a mains failure. If by pressing the test push button the alarm sounds only weakly, this is a sign that the battery requires replacement. As no current is taken from the battery except under alarm conditions, replacement in most

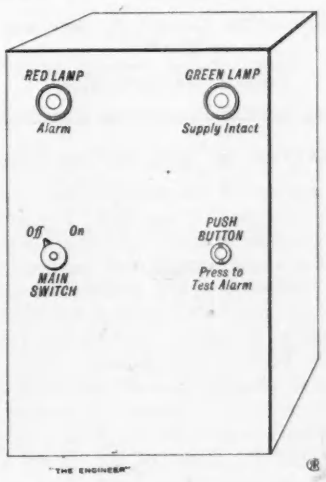


FIG. 6—ALARM UNIT

cases will not be necessary for twelve to eighteen months.

Practical tests have been carried out over a long period with actual incendiary bombs (in some cases with actual German "kilo" bombs) and the final design, for which a patent application has been made, embodies all the experience gained from these tests.

The particulars given in this article have been supplied to us by Dr. Walter Stern, of Londex, Ltd., London, who desires to acknowledge the assistance given him in the development of the system described by Vice-Admiral the Hon. A. Stopford, C.M.G., W. S. Forster-Brown, W. Steljes, and W. G. Bird, Chief Officer of the Wimbledon Fire Brigade.

The Engineer

APRIL 4, 1941

VOL. CLXXI No. 4447

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BATTLE OF THE IONIAN SEA

THE anxiety of English-speaking people all over the globe, and of their many foreign friends, to have an official story of the brilliant sea and air fight in the Ionian Sea last week has been satisfied by the Admiralty with a rapidity for which all are very grateful. On Tuesday last it issued to the Press a narrative covering the events of Thursday, Friday, and Saturday, which, though it is naturally lacking in details, enables the reader to follow with fair closeness the progress of the action from the moment the Italian ships were sighted until the flight of the enemy and the increasing darkness put an end to the engagement. This narrative is reprinted on an adjoining page with some illustrations of the ships sunk or damaged in the fight. It leaves one question that has been in everybody's mind unanswered. Why had an Italian fleet ventured to enter what it ought to have known was a dangerous area? The Commander-in-Chief concluded that its intention was to attack convoys between Egypt and Greece. If that were indeed the case, it is doubly astonishing that the reconnaissance work of the Italians was so bad that they were caught virtually unready for the action.

For many years a contest has raged over the problem of aircraft *versus* warships. It has turned mainly upon the use of bombs against moving targets, and the events of the war have given a good deal of support to those who held that the bomb was not greatly to be feared. It has been shown over and over again since hostilities started that it is exceedingly difficult to hit a ship from high in the air, even when she is stationary, and ten or twenty times as difficult when she is in motion, and can take evasive action. But it has been made abundantly clear that the Navy has been developing a new tactic, and that it has brought it to a high degree of perfection in the Mediterranean Fleet by constant exercise and practice. That tactic is the use of the dive bomber equipped with torpedoes. We saw at Taranto what wonderful results could be attained against ships at anchor, and the Battle of the Ionian Sea has demonstrated beyond all cavil the effectiveness of the same form of attack against a first-rate ship moving at high speed. The *communiqué* issued by the Admiralty on Monday last says: "During the day (Friday) the 'Littorio' class battleship was repeatedly and successfully attacked with torpedoes by our naval aircraft. The battleship was seriously damaged and her speed was considerably reduced." Later evidence seems to indicate that attacks on this ship, believed to have been the "Vittorio Veneto," were continued and that there is some likelihood she was so holed that she sank before reaching harbour. It is now definitely known that one cruiser was also hit by a torpedo from a bomber. The aircraft which effected these master strokes belonged to the Fleet Air Arm, and took off from H.M.S. Aircraft Carrier "Formidable," but the R.A.F. also contributed in a very large measure to the general victory. The *communiqué* states that "a successful attack was also made by bombers of the Royal Air Force, who scored several hits on cruisers and destroyers. The loss of speed resulting from these air attacks enabled our heavier ships to gain contact with the enemy." The R.A.F. attacks were made with Blenheim bombers, and it was claimed that two direct hits were scored on one cruiser, one direct hit on a destroyer, and two probable hits on another cruiser. Apart from these positive results, slowing up of the enemy resulted from the continuous harassing from the air and the necessity to take "evasive action." Once this reduction of speed had been effected, the end of the action was inevitable. Our battleships had time to come within easy range, and though darkness had fallen a few salvos from their great guns put an end to the Italian cruisers. The British Fleet returned to Alexandria without a scratch on its paint or a single casualty, whilst the enemy suffered such loss that, coming upon the top of its losses at Taranto and elsewhere, the Italian navy can no longer give us grave concern in the Mediterranean.

In this brilliant naval action one fact stands out clearly above all others. In his Continental campaigns Hitler used his air force in co-operation with his army; Admiral Sir Andrew Cunningham has adopted the same plan on Britain's own element, the sea. For the first time a battle in which sea power and air power were completely and skilfully united has been fought. The result is transcendent. It is the complete vindication of that policy which has always foreseen that aircraft, and with them the aircraft-carrier, would be essential to battle fleets. Henceforward, no Power will willingly and hopefully enter upon a fleet action unless it can count upon ample support from the air. Admiral Cunningham and Air Chief Marshal Longmore have brought the unity of the air force and the sea force to perfection by constant practice, and to them we owe the full opening of a new era in naval warfare.

Bombing Raids

ONE cannot expect official figures of relative air strengths to be available in time of war; such figures as do appear are unofficial and must be based on little more than intelligent guessing. But competent observers can make shrewd estimates and in such a matter no one would doubt the ability of the engineering vice-president of the Curtiss-Wright Corporation of America, Mr. T. P. Wright. His estimates published recently in an American journal have created very great interest. There has also been issued a German account of the raiding carried out on this country by the *Luftwaffe* during the last five months of 1940. These two sets of figures it is of interest to examine side by side, since they have an important bearing on each other. The German authorities are no doubt aware of the precise quantity of bombs with which their raiding aircraft were armed, but they cannot really know the proportion actually dropped over Britain, since many will have fallen into the sea either through the destruction of the bomber before it reached these shores, or because the target chosen was a ship at sea or in harbour; the German estimate of the weight of bombs dropped by our aircraft over that country is of still less value; indeed, it is hardly worth consideration, since once a bomb has detonated it is rarely that one can be certain of its original size or weight; even a bare enumeration of numbers cannot be accurate.

Taking the German figures as they stand, 43,000 tons of bombs are said to have been dropped in Britain during 1130 raids in the months of August to December last (140 days). This corresponds to 40 tons per raid and eight raids per day. If we put the average bomb load at 2 tons we shall probably be exaggerating, since some raiding was done by adapted fighters capable of carrying only a few hundred pounds. It will be best to assume a rather lower figure and put the average number of bombers per raid at 40, which at eight raids per day requires a daily total of 320 aircraft. This figure may be compared with Mr. Wright's estimated total of Germany's aircraft strength at the close of the last year. His figure is 35,000, of which he expects 10,000 to be fighters and bombers (apart from certain reserves). If of these 10,000 aircraft there was an equal number of fighters and bombers, we have a direct comparison of the figure of 5000 bombers with the average number of 320 bombers operating every day against this country—a proportion, when allowance is made for other possible "fronts," of some 10 per cent. Admittedly, there is considerable uncertainty about these figures, but they are probably as good as any we can get, and taking them as they stand it would appear that the *Luftwaffe* was nearly "all out" during that long period. It represents a high daily average; but, according to the German account, in the "mass raids" which took place on some days as much as 700 tons of bombs were taken, probably calling for the use on each such raid of some 500 aircraft (apart from escorts), which must have been very near the operational limit. One has to think not only of the maintenance of airframes and engines, but the supply of bombs and other ammunition, the servicing of the guns and the multitudinous auxiliary equipment which has to be carried—and that most difficult supply of all, the fully trained pilots and their crews. So much for the immediate past; what of the future? Owing to the growing use of armouring a somewhat uncertain correcting factor needs to be introduced into our estimates. The collapse of France facilitated the operations of the *Luftwaffe*, since French aerodromes vastly nearer to British target areas became available. Less petrol had to be carried and more bombs or a greater weight of armouring could be used. The need for armouring became exceedingly urgent because of the effectiveness of the gunfire from our splendid fighter aircraft. How far this may have decreased the potential carrying capacity of German bombers is uncertain. But with the increasing use of cannon guns the call for yet more armour becomes greater still, and this again must lower the bomb loads which can be carried.

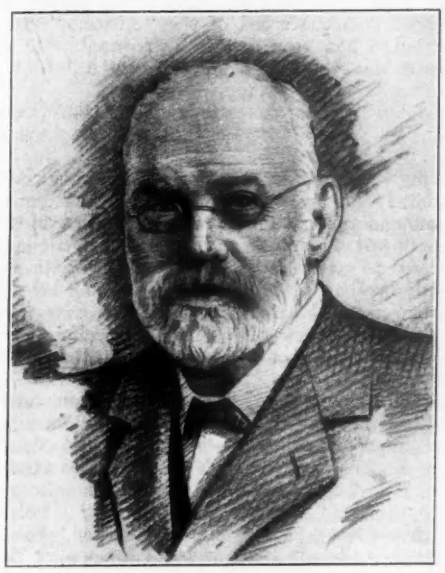
According to Mr. Wright's curves, German production is approaching its peak, and German and British figures of total strength will be equal before the close of this year, this without counting upon the arrival of our share of the 15,000 American aircraft which he expects to be ready by then. If we receive half of this American output we should, according to Mr. Wright, be level with the German figures by this summer. Hence the coming increase in the tonnage of bombs dropped will appear on the credit side of the R.A.F.'s account rather than on that of the *Luftwaffe*.

We have for long had good reason to look upon the technical merits of our aircraft as ahead of those produced in Germany, and it is reassuring to be told on good authority that even in aggregate totals of strength we shall not need to fear comparison.

Obituary

GEORGE REVEIRS

THE ENGINEER mourns to-day the loss of a very old and tried friend in the person of Mr. George P. Reveirs, head of the firm which almost from the beginning has printed this paper. A few years after our foundation in 1856 an earlier George Reveirs took over the printing business which was then producing the paper, and for many a year he printed THE ENGINEER. This earlier George died full of love and respect in 1911, and his son, George, became master printer in his stead. Never has a paper been served so faithfully and so loyally as by these two. It may truly be said of them that they took as much pride in its production as if it had been their own property. We are happy to be able to say that



G. P. REVEIRS

there is with us still yet a third George Reveirs, grandson of the founder, who with his uncle Harry Reveirs and his brother Archibald, carries on the long tradition of devoted service.

Mr. George P. Reveirs was an old man; he was eighty-three years of age, and began his training under his father, when he was a mere lad. He worked through his apprenticeship like any other 'prentice, for his father had strong views and a strong will. Hence he had learned every aspect of his business from A to Z, and there was nothing that he knew that he was not always ready to put at the service of those for whom he worked. A most upright and candid man in all his dealings, he was quite incapable of any mean act, and would far rather sacrifice his own interest than take advantage of others. He won and deserved the affection of all who were admitted to his friendship, and enjoyed the respect of the industry to which he belonged. The passing of such men is always sad, but our grief is softened in this case by the fact that George Reveirs lived to a good age and that almost to the last he had been active in body and mind. He died in the fulness of time, having done his duty throughout a long life as a large-hearted gentleman.

Literature

Engineering Economics. Book I. By T. H. BURNHAM, B.Sc., B.Com., A.M.I. Mech. E., and G. O. HOSKINS, B.Com., B.Sc. Fifth edition. London: Sir Isaac Pitman and Sons, Ltd. 1940. Price 10s. 6d. net.

THE increasing interest that is being taken in engineering economics is evidenced by the fact that the book before us is the fifth edition of a work which made its first appearance only eleven years ago. The author (or we should now say authors) appreciate the necessity for keeping abreast of the times by a careful revision, which has led to the rewriting of a good deal of the subject matter, and we notice that a new chapter dealing with the trade cycle is included. While the book is admittedly of special use to the student who is preparing for the examinations of the different engineering institutions, we are informed that this is only its secondary object, the primary one being "to introduce the engineer to a study of the techniques that impinge on and affect his own technique"; certainly it should prove valuable to all engineers who desire to widen their outlook and to appreciate the many problems that are so closely interlocked with those of production. We fully agree that "neither engineer nor scientist is playing his full part in society if he confines his outlook to technical problems," while it is true that the spirit of *laissez-faire* must give place to planning, for *laissez-faire*, which knows no plan, has led to the downfall of many an enterprise.

In one respect the arrangement of earlier editions was better, in that the author, after introducing the elements of economics, followed with a short industrial history, which tended to arouse a keener appreciation of how problems developed, before he started to probe too deeply into detail. The historical part of the subject is now found well on in the book in a chapter entitled "Industrial Evolution." Incidentally, the authors speak of the period which began with the great depression of the early 1930s as the "second industrial revolution." While it is admitted that much has been accomplished in the way of reducing production costs, the changes have been in the nature of evolution rather than revolution.

The subject of the trade cycle is treated fairly, and we are given the generally accepted reasons for the slump that follows the boom period, which, in its turn, had relieved a state of depression! The way to avoid these depressions is a subject that warrants close study. Some consider that the solution is to be found in the prosecution of public works, and colour is lent to this argument by the fact that an approaching slump in this country was staved off when the 1938–9 rearmament programme brought down the unemployment figures. War itself tends to eliminate unemployment and to produce an apparent boom, which industrialists fear on account of the slump that will inevitably follow in the trade cycle!

This work is largely concerned with the commercial side of engineering, so that matters pertaining to money, banking resources, industrial and commercial legislation, control and distribution, are discussed in a very lucid manner, while the value of statistics and charts is clearly shown. The more intimate problems of works management and organisation are reserved for the second book. It is realised that most engineers are keener on those principles that directly affect the works, but for that very reason they should be inspired to seek to understand those wider considerations that lie outside their daily lives, and for this purpose this book is eminently suitable in that it does not delve too deeply into the subject but sets out the main features in a readable and interesting manner. The chapter dealing with industrial relations is of importance, and it is true that "engineers sooner or later will find themselves in the midst of problems of labour relations," and it is essential for them to know something of the circumstances that led up to the trade union movement, to the formation of federations of employers and of industries, as well as of trade associations, cartels, and the like.

We confess that we miss the extensive bibliography that appeared at the end of each chapter in the earlier editions, for the authors now content themselves with short lists of books for "further reading"; but they have done well to divide these into two categories: (*a*) easier works suitable for all readers, and (*b*) more advanced works.

SHORT NOTICES

The Sirhowy Valley and its Railways. By D. S. BARRIE and CHARLES E. LEE. London: The Railway Publishing Company, Ltd. 1940. Price 3s. 6d.—The railways of the Sirhowy Valley served the mining interests of South Wales and Monmouthshire. Needless to say, they have long since been absorbed. But to the railway historian they are of great interest, both in respect of their permanent way and their engines. We are grateful, therefore, to the authors for having collected in a convenient form so much information. The pamphlet is bound, well printed and full of illustrations, pictorial, technical and cartographical. There were several little railways, tramways and plateways in this busy area in the first half of last century, one of the authors' maps showing half a dozen in a region which includes Ebbw Vale, Tredegar, Trevil and other well-known names. Nearly all these lines, if not all, still stuck to the plate rail, when in the North-East the edge rail was rapidly supplanting it. The reason for this conservatism was that the "ways" could be used by ordinary wagons and were not reserved exclusively to railway stock. Thus in a sense passenger traffic began on railways—or strictly plateways—much earlier in this district than elsewhere—even as early as 1807. Amongst locomotives of the Sirhowy Valley may be mentioned the famous "Speedwell," with its vertical cylinder and bell-crank lever operating the connecting-rod. In this connection the authors will perhaps allow us to draw their attention to a very full description and discussion of this engine by Mr. Dendy Marshall in our issue of January 29th, 1937. As far as we can discover it has escaped their attention. We ought to add, in conclusion, that much of the material of this pamphlet appeared in serial form in the *Railway Magazine* in 1939 and 1940.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

MACHINING H.E. SHELL

SIR,—"M.I. Mech. E.," in his letter of the 8th inst., is hardly correct in assuming there is a clear saving in cost by the elimination of boring in the finish-forged cavity shell body, in that it necessitates much more careful forging, a higher standard of accuracy in the forging presses themselves, with more exacting production conditions, while subsequent machining operations are not as easy as on a shell that has a bored interior on which operations can be based.

The finish-forged cavity shell was evolved some years before the war primarily to ensure a maximum economy in material, as it was realised that in wartime the resources of steel production and of swarf disposal would be taxed to the utmost. Much could be said for and against the unbored shell.

The question of abandoning the base plate is an interesting one, but even if the risk to human life is less now with improved steel and with better forging, it is at least well sometimes to err on the safe side.

ANOTHER M.I. MECH. E.

March 26th.

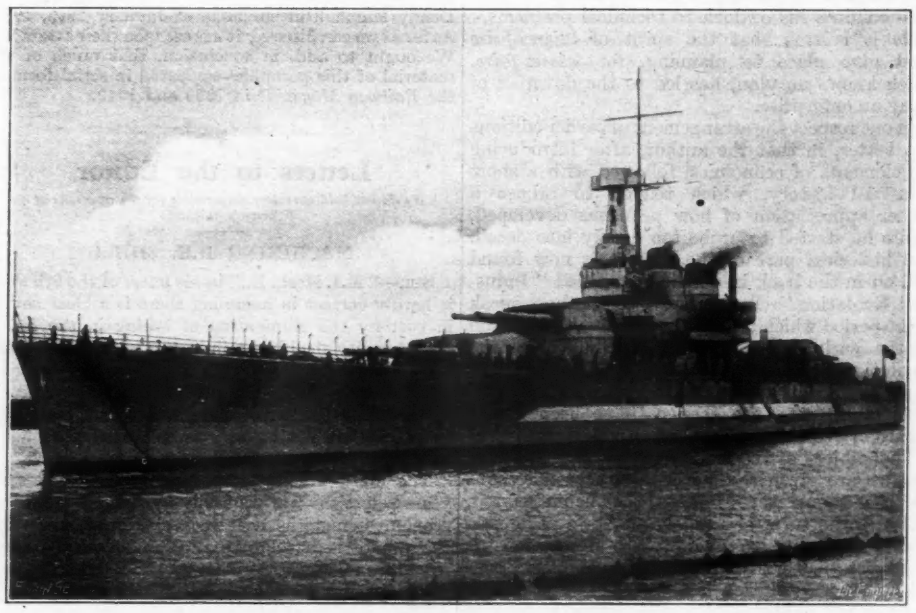
Sixty Years Ago

STEEL SHIPS AND BOILERS

IN a paper read before the Institution of Naval Architects on April 6th, 1881, Mr. J. Samuda described the corvette "Almirante Brown," which he had designed and built for the Argentine Navy. He claimed that this vessel was the first warship to be built entirely of steel and fitted with steel-faced armour. The steel used was of the Siemens variety. The armour consisted of steel-faced plates with a teak backing and was fixed to the hull plating by means of bolts and nuts from the inside, care being taken that the bolts did not wound the steel face. Transverse bulkheads and steel decks divided the hull into forty-eight water-tight compartments. The armament consisted of six Armstrong 8in. breech-loading guns arranged within an armour-plated battery above the main deck and six 4½in. broadside guns on the upper deck. The ship was driven by twin screws operated by two sets of inverted compound condensing engines indicating together 4500 H.P. To the naval architect of those days steel as a shipbuilding material was still suspect, for it was undoubtedly true that occasionally one of a batch of plates would prove very brittle. Nevertheless, the use of steel instead of iron was attractive, because of the economy of structural weight which it permitted. Mr. Samuda, concluding his address, gave figures which showed to what extent steel economised weight as compared with iron. An iron ship protected by iron armour to the same degree as the "Almirante Brown," and having the same speed, draught, and radius of action, would, he said, have had a length of 260ft., a breadth of 55ft., and a displacement of 5200 tons, and would have required engines of 5000 H.P. and bunkers to hold 720 tons. The steel ship had a length of 240ft., a breadth of 50ft., and a displacement of 4200 tons, her engines being of 4500 I.H.P., and her bunker capacity 650 tons. The discussion which followed the reading of Mr. Samuda's paper seems to have been enlivened by Sir E. J. Reed, who took advantage of the occasion to criticise the design of H.M.S. "Inflexible," "for the benefit," so we wrote, "of Mr. Barnaby and Mr. White"—Sir Nathaniel Barnaby and Sir William White, his successors in office at the Admiralty. These two gentlemen, we said, listened to Sir Edward's criticism with "silent gestures of dissent," until the President, Lord Ravensworth, came to the rescue by reminding Sir Edward that time was pressing.

The Battle of the Ionian Sea

ON the morning of Monday, March 31st, it became known that the Mediterranean Fleet, under the command of Admiral Sir Andrew Cunningham, had on Friday, March 28th, inflicted a severe defeat on the Italian Navy, which has resulted in severe damage to and the possible loss of one battleship of the "Littorio" class, the total destruction of three cruisers of the "Zara" class, and the loss of two, if not three, destroyers,



ITALIAN 35,000-TON BATTLESHIP OF THE "LITTORIO" CLASS

with probable damage to another light cruiser of the "Condottieri" class.

The Admiralty issued on Tuesday last the following narrative, giving a connected account of the action which took place off Cape Matapan in Greece, so far as detailed information is yet available :—

About midday on Thursday, March 27th, air reconnaissance reported that enemy cruisers were at sea to the south-eastward of Sicily. The Commander-in-Chief, Mediterranean, was then at Alexandria with the main body of his fleet. It was immediately clear to him that these enemy cruisers could not be up to any good, and he concluded that their probable intentions were to attack our convoys between Egypt and Greece. Acting on this supposition he made the following dispositions of the forces at his disposal :—The Vice-Admiral Commanding Light Forces (Vice-Admiral H. D. Pridham-Whippell), with his flag flying in H.M.S. "Orion" (Flag Captain G. R. B. Back), had with him the cruisers "Ajax" (Captain E. D. B. McCarthy), "Perth," of the Royal Australian Navy (Captain Sir P. W. Bowyer-Smyth, Bt.), and "Gloucester" (Flag Captain H. A. Rowley), and some destroyers. This force the Commander-in-Chief, Mediterranean, ordered to proceed to a position south of Crete, in which it would be strongly placed to intercept any enemy forces attempting to interfere with our traffic with Greece.

The Commander-in-Chief, whose flag was flying in H.M.S. "Warspite" (Flag Captain D. B. Fisher), had with him the battleships "Valiant" (Captain C. E. Morgan), and "Barham" (Flag Captain G. C. Cooke), flying the flag of Rear-Admiral H. D. Rawlings, O.B.E., the aircraft carrier "Formidable" (Flag Captain A. W. La T. Bissett), flying the flag of Rear-Admiral C.W. Boyd, C.B.E., D.S.C., and some destroyers. This force was ordered to raise steam with all dispatch. In the afternoon of March 27th the Commander-in-Chief took his main fleet to sea from Alexandria and steamed to the north-westward in the hope of intercepting enemy forces and bringing them to action.

At 7.49 a.m. on March 28th air reconnaissance reported an enemy force, consisting of one "Littorio" class battleship, six cruisers, and seven destroyers about 35 miles south of Gavdo Island. This enemy force was steering to the south-eastwards, and soon after being sighted it was seen to be joined by two more cruisers and at least two more destroyers. At the time when they were seen the Vice-Admiral Commanding Light Forces, with the cruiser force, was about 40 miles to the south-eastward of the enemy. The Commander-in-Chief with the main fleet was then about 95 miles to the south-eastward of the cruiser force, and steaming to the north-westward. Acting on the aircraft report of sighting the enemy, our cruiser force altered course to the northward and made contact with enemy cruisers at 8.2 a.m. Having made contact, the Vice-Admiral turned his cruisers to the south-eastward in order to draw the enemy on towards the battle fleet.

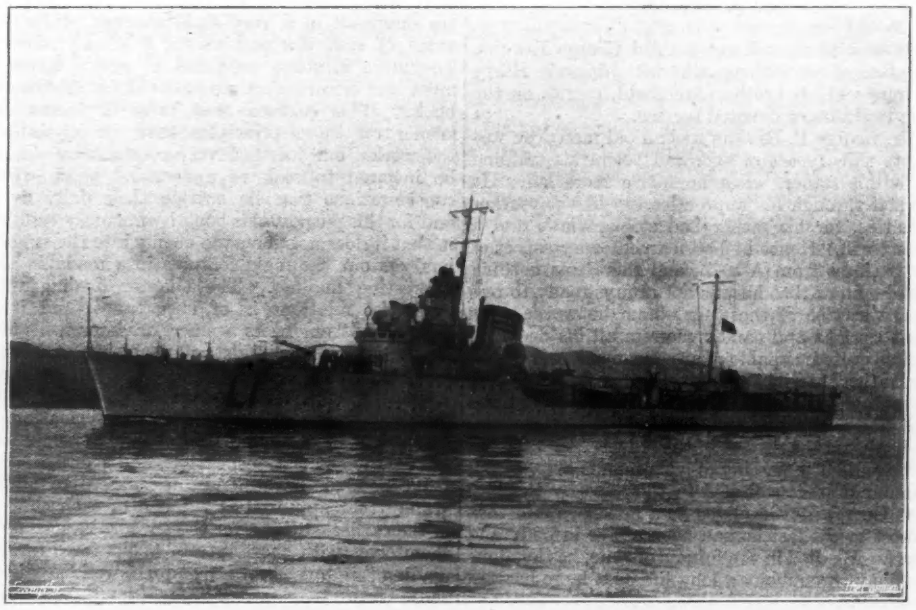
About 9 a.m. the enemy cruisers turned 16 points and began to steer to the north-westward. The British cruiser force followed suit in order to keep in touch. This they did until 10.58 a.m., when the V.A.L.F. saw the "Littorio" class battleship 16 miles to the northward. On sighting the enemy battleship he turned his cruisers once again to the south-eastward, in order to keep outside range of the heavy guns of the enemy battleship and to draw the enemy forces towards his Commander-in-Chief.

A torpedo bomber attack was launched from H.M.S. "Formidable," and this developed on the "Littorio" class battleship at 11.30 a.m. One possible hit was claimed in this attack. Either this attack or the knowledge of the presence of an aircraft carrier caused the "Littorio" class battleship and her accompanying cruisers to turn to the north-westward. The enemy was thus again heading for his bases. This abrupt turn by the enemy caused the V.A.L.F. to lose touch, but our cruiser force almost immediately came in sight of our own battle fleet, and the whole of our forces pressed on after the enemy. At 11.35 a.m. our aircraft saw and reported a second enemy force about 80 miles west of Gavdo Island. This force consisted of two "Cavour" class battleships, three cruisers, and four destroyers.

At about this time another torpedo bomber attack by naval aircraft was launched against the enemy force, which included the "Littorio" class battleship. One hit was claimed in this attack. During the first hours of the afternoon naval aircraft again carried out a search for the enemy, with whom touch had been temporarily lost. The enemy was again located. A further torpedo-bombing attack was launched, and in this attack three torpedo hits on the "Littorio" class battleship were claimed. Between 3 p.m. and 5 p.m. Blenheim bombers of the R.A.F. attacked the enemy with bombs. In these attacks it was claimed that two direct hits were scored on one cruiser, one direct hit on a destroyer, and two probable hits on another cruiser. At four o'clock the Commander-in-Chief received a report from aircraft that the speed of the "Littorio" class battleship had been drastically reduced. He at once ordered the Vice-Admiral to press on with his four cruisers to regain touch.

At dusk two more torpedo-bombing attacks were launched by naval aircraft. It is not thought that the "Littorio" class battleship was again hit during these attacks, but one enemy cruiser was definitely hit by a torpedo. The Vice-Admiral Commanding Light Forces regained touch with the enemy just after dusk and some destroyers were ordered to attack, others being retained with the battle fleet for screening duties. Having led the destroyers to the position from which they were to commence their attack, the Vice-Admiral led his cruisers clear of his destroyers to the north-eastward.

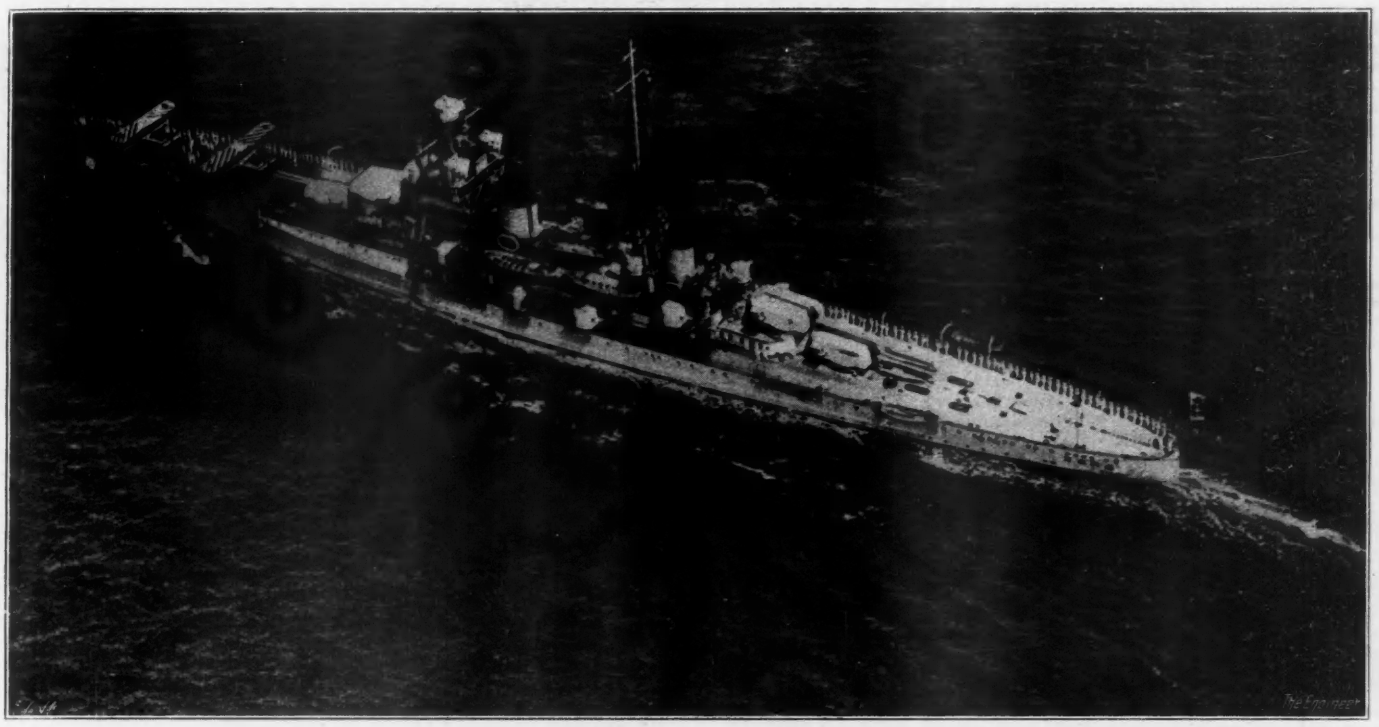
At 10.10 p.m. it was reported to the Commander-in-Chief that an enemy vessel was lying damaged and stopped 3 miles to port of the battle fleet's course. The Commander-in-Chief at once turned the battle fleet to engage this unit. It is now known that this ship was the Italian cruiser "Pola." While the battle fleet was approaching the "Pola"



ITALIAN 1,449-TON DESTROYER OF THE "GRECALE" CLASS

three enemy cruisers were seen on the starboard bow. This enemy force consisted of two "Zara" class cruisers led by a smaller cruiser of the "Colleone" class, and it was crossing the bows of our battle fleet from starboard to port. As the enemy cruisers passed ahead of the screen, H.M.S. "Greyhound" (Commander W. R. Marshall-A'Deane) illuminated the leading heavy cruiser. Our battle fleet at once opened fire. The enemy must have been taken completely by surprise. The first salvos hit at a range of about 4000 yards, and practically wrecked both the heavy cruisers

ITALIAN 10,000-TON CRUISER "ZARA" SUNK IN IONIAN SEA



of the "Zara" class so far as fighting was concerned.

Enemy destroyers which were astern of the cruisers were then seen to turn and fire torpedoes, and our battle fleet turned away to avoid them. Exactly what followed is still obscure, but H.M.A.S. "Stuart" (Captain H. M. L. Waller) and H.M.S. "Havock" (Lieut. G. R. G. Watkins) certainly did considerable execution. The attacking force of destroyers, which was searching for the damaged "Littorio" class battleship, failed to locate her, and it seems probable that she moved off during the action between our battle fleet and the enemy cruisers. Some of the destroyers from this attacking force subsequently made touch with the destroyers sent in by the Commander-in-Chief to mop up, and they assisted in sinking the "Zara" and the "Pola."

It appears probable that during the night the "Littorio" class battleship became heavily engaged with her own forces, as heavy gunfire was heard at a time and from a direction which made it impossible for any of our forces to be engaged.

As soon as it became possible that a fleet action might take place, a force of Greek destroyers steamed out to the westward in the hope of intercepting enemy forces endeavouring to escape into the Adriatic. Unfortunately, the line of the enemy retreat did not give them an opportunity to attack. Extensive air search next morning failed to disclose any of the remaining Italian ships, which must have made their escape under cover of darkness.

The results of this action, so far as is at present known, are that the heavy cruisers "Zara," "Pola," and "Fiume" were sunk; one 6in. gun cruiser of the "Colleone" class was probably sunk; the large Italian destroyer "Vincenzo Gioberti" and the destroyer "Maestrale" were sunk; and the large destroyer "Alfieri" probably sunk. The new battleship of the "Littorio" class sustained serious under-water damage, and other enemy units were also certainly damaged.

None of our ships sustained either damage or casualties. The total British losses during these operations were two naval aircraft.

These highly successful engagements in the Mediterranean can be accounted historic for two reasons. It is the first occasion in history in which skilful co-ordination of naval operations with attacks launched by aircraft has resulted in the enemy's speed being reduced and our main units being able to force action upon a reluctant enemy. It is also the first occasion in naval history in which such severe losses have been imposed upon the enemy while our own forces were completely unscathed.

On arrival back in port, the Commander-in-Chief, Admiral Sir Andrew Cunningham, issued the following message:—

Operations just concluded have given us a notable success over the enemy.

The skilful handling of our cruisers and the untiring efforts of the Fleet Air Arm kept me well informed of the enemy movements, and the well-pressed-home attacks of torpedo-bomber aircraft on the "Littorio" so reduced the speed of the enemy fleet that we were able to gain contact during the night and to inflict heavy damage.

The devastating results of our battleships' gunfire are an ample reward for months of patient training.

This work was completed by the destroyers in the admirable way we have come to expect of them.

The contribution of the engine-room departments in this success cannot be over-emphasised. Their work, not only in keeping their ships steaming at high speed for long periods, but in the work of maintenance under most difficult conditions, has been most praiseworthy.

I am very grateful to all in the Fleet for their support on this and on all other occasions. Well done!

With this article we illustrate three of the principal classes of the Italian naval vessels. The "Zara" is the name-ship of its class, which included four heavy cruisers, the "Zara," "Fiume," "Goritza," and "Pola," three of which were sunk. They have a standard displacement of 10,000 tons, with a length of 599ft. 6in., a beam of 67ft. 8in., and a draught of 19ft. 6in. The armament comprises eight 8in. guns, twelve 3·9in. guns, and ten 37 mm., with eight 13 mm. anti-aircraft guns. The thickness of armour is 5½in. at the sides and 5in. at the turrets, with 4½in. for the transverse bulkheads and 2in. on the deck. The propelling machinery comprises a twin-screw arrangement of Parsons geared turbines, taking steam from eight three-drum boilers working at 300 lb. pressure. The designed output of the machinery is about 95,000 S.H.P., corresponding to a speed of 32 knots. The "Zara" was built at the Odero-Terni-Orlando yard, and was laid down in July, 1929, and completed in October, 1931.

The "Littorio" class battleship "Vittorio Veneto," was built at the C.R.D.A. yard at Trieste, and was laid down in October, 1934, and finished in April, 1940. She has a standard displacement of 35,000 tons and her principal dimensions are 775ft. overall, beam 106ft. 6in., and mean draught 28ft. Her armament comprises nine 15in. guns, twelve 6in. guns, twelve 3·5in. anti-aircraft guns, and forty smaller anti-aircraft guns. She carries three aircraft and has two catapults. The main armour belt varies from 9in. to 12in. in thickness. There are four sets of geared steam turbines of the Parsons type, taking steam from high-pressure water-tube boilers, and the designed output of the machinery is about 130,000 S.H.P., corresponding to a speed of 30 knots, which was exceeded on trial. These battleships were built to the designs of Engineer-Inspector-General Umberto-Pugliese. The large destroyer which was sunk was the "Maestrale," a ship of the "Grecale" class. The "Maestrale" was built at the Riuniti yard, and had a displacement of 1449 tons. Her dimensions were 350ft. overall, breadth 33ft. 4in., and draught 10ft.; she was armed with four 4·7in. guns, eight 37 mm. and four 13 mm. anti-aircraft guns, and six 21in. torpedo tubes. Her engines consisted of twin-screw Parsons geared turbines taking steam from three three-drum boilers. The turbines had a designed output of 44,000 S.H.P., corresponding to a speed of 38 knots. These ships were laid down in 1931, and were completed in 1934.

Technical Reports

Fire Protection of Structural Steelwork: Wartime Building Bulletin No. 13. D.S.I.R. London: H.M. Stationery Office. Price 1s. net.—It has been estimated that for every ton of steelwork irreparably damaged by high-explosive bombs at least 10 tons have been destroyed by fire. The fire protection of structural steelwork is therefore of first-class importance. This bulletin therefore commands attention because it deals with this important subject. Structural precautions against fire and the organisation of fire-fighting arrangements should go together. The more effective the structural precautions, the less will be the effect of any fire started and the easier it will be to deal with. The bulletin is divided into two parts. In the first, simple rules are given for assessing the degree of protection appropriate to different occupancies, having regard, however, to the accessibility of fire-fighting services. The second part then shows how the different degrees of protection may be obtained. A variety of treatments are described, and in most cases illustrated, and tables are given relating the thickness of treatment to the degree of protection provided. There is added a list, furnished by the Building Centre, of firms known to supply products of the type described. The suggestions in the bulletin deserve study for application both to new and existing factories, for even where, in existing factories, the beams and trusses would be overloaded by application of heavy fire-protection material, treatment of the stanchions alone will limit the damage.

To Cleanse Lubricating Oil.—A new type of magnetic separator has been developed for removal of the iron particles from used oil. It consists of a two-piece case in which are mounted two magnets made of a nickel-aluminium-titanium-iron alloy. Between these magnets, and within a pair of bronze tubes used to direct the flow of oil, is a series of grids made from a high-permeability alloy. Magnetic particles of iron flowing into the filter are held either on the magnets themselves or on the large grid area, which is magnetically energised by the flux of the two magnets.

Fuses with Striker Pin Tripping Devices

A FUSE may be used with advantage as a back-up or short-circuit device for circuit breakers. But in the majority of cases all three fuses in a three-phase circuit must blow before the circuit is entirely disconnected. If only one fuse blows, as a result, for instance, of a fault from one line to earth, the circuit is maintained *viâ* the other two lines. No indication of the state of affairs is given to the operator and

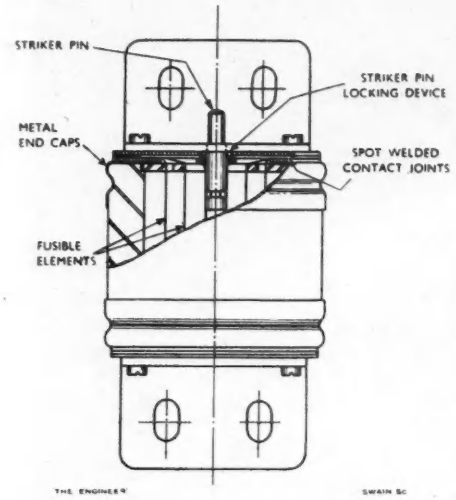


FIG. 1—ARRANGEMENT OF FUSE AND STRIKER PIN

motors may continue to run as modified single-phase machines with consequent overheating of cables and machine windings and risk of breakdown. This condition cannot be taken care of by under-voltage releases and the only solution is to trip out the breaker. To meet the requirements a new high rupturing capacity fuse with a striker pin tripping device—Fig. 1—has been introduced by Johnson and Phillips, Ltd., of Charlton, London, under the designation EETEE/JP.

In the new fuse the fusible elements are housed in a ceramic holder of heat-resisting material with a low coefficient of thermal expansion. The space within the holder is packed with a filling powder selected for its arc extinguishing property. Silver forms the main current carrying elements, but after these have melted owing to the fault current, the whole of that current is transferred to a shunt wire of high-resistance tungsten. This element, which finally melts to clear the circuit, is used to prevent harmful rise of voltage after clearance. The construction of the silver elements is such that by their non-uniform section grading is obtained so that various sections operate in

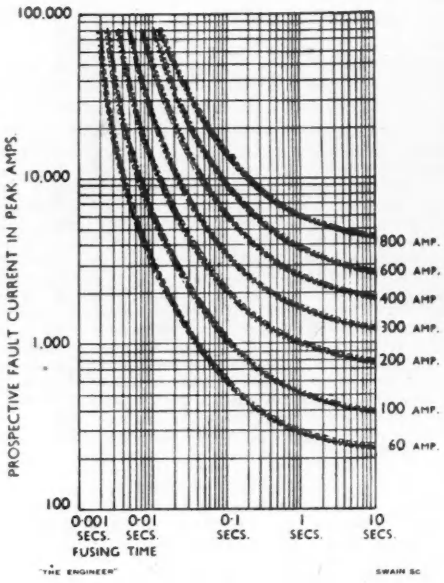


FIG. 2—TIME-CURRENT CHARACTERISTICS

sequence. By variation in these sections a series of time/current curves can be produced to suit any particular application. End fittings are rigidly attached to the body and no cement is used. All internal contacts are spot welded. The tripping device consists of a striker pin built into the body of the fuse. In series with the tungsten wire there is a weak fusible section connected directly to the striker pin. This weak section dissipates shortly before final clearance of the circuit and causes the ignition of a small chemical charge contained below the piston of the striker pin. By the firing of this charge the striker pin is forced outwards to trip an associated switch. The mechanical movement of the striker pin lasts approximately one-quarter of a second and this short interval ensures that the actual electrical interruption through the tungsten element has long been completed before the striker pin has tripped the breaker or switch. Tests have shown that the striker pin begins to move three to five cycles after interruption is complete. A locking catch is provided to prevent the striker pin returning once it has been driven out. Thus the pin not only operates the breaker or switch, but also serves as an indication as to which fuse has blown. Some curves reproduced in Fig. 2 show the time current characteristics of a family of fuses. The ratio of actual current which passes to the prospective peak current under fault conditions varies with the normal current rating of the fuse. In Fig. 3 the full-line curve is that of a fully asymmetric prospective current wave equivalent to 25 mVA at 400 volts (89,000 amperes). At various points on this curve are shown the points at which the main fuse

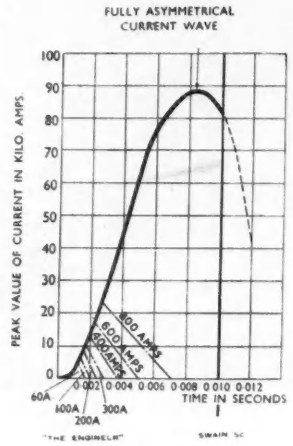


FIG. 3

melts to cut off the current. The dotted lines back to the base represent the die-away of the current through the shunt wire. It will be noted that the diagram shows all fuses operating to clear fully within one-half cycle.

The present range of EETEE/JP fuses is credited with a breaking capacity of 30 mVA at 400/440 volts. This rating, it is claimed, is not an arbitrary one, but one which has been fully proved by short-circuit tests.

The introduction of the new fuse has made possible the design of new types of low-voltage switchgear, both oil and air breaker, the breaker being automatically opened when one or more fuses operate.

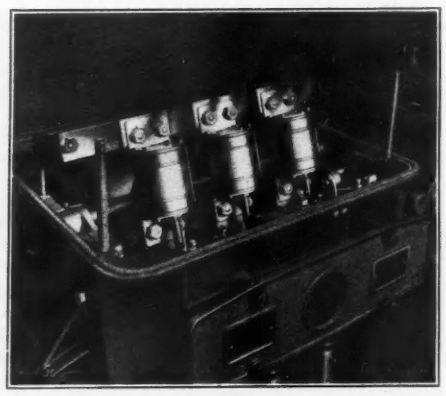


FIG. 4—OIL CIRCUIT BREAKER WITH FUSES

In Fig. 4 there is illustrated a typical ironclad industrial oil circuit breaker fitted with the new fuses. The fuses are carried on a chassis in such a way that the tripping plunger impinges on the same trip bar that is provided for overload and other protective devices. The arrangement, it is claimed, converts a breaker of relatively low breaking capacity into one of high breaking capacity in addition to the fact that all three phases are tripped, though only one fuse operates.

The firm has also introduced a design of air break switchgear making special use of the new fuses. The switch proper takes the form of a modified circuit breaker latched in by a simple but effective mechanism. While maintaining high-pressure contact in the closed position, the design of the mechanism is such that only a light blow *viâ* the fuse tripping plunger is necessary to release the mechanism. A typical switch fuse unit in the closed position is illustrated in Fig. 5. Contacts are of the contactor type, making line contact under high pressure. It is stated that in making and breaking a definite wiping action occurs at the contact faces. Contacts are of the unit type and are easily renewable. A quick break action of the switch when opening ensures that the circuit cannot be disconnected slowly. To each phase there is fitted a specially designed arc chute which provides an effective barrier and is arranged so that the arc is drawn well up into the chute. This new automatic air break switch fuse gear can be built up into switch-

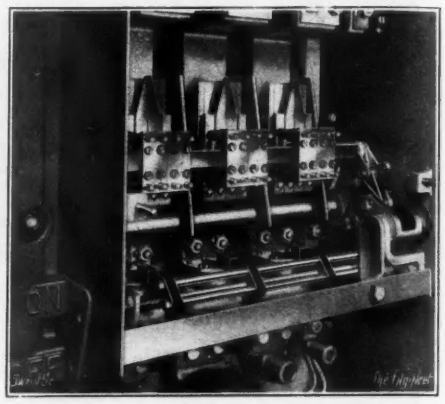


FIG. 5—AIR BREAK SWITCHGEAR WITH FUSES

board form. Units may be mounted above or below bus-bar chambers and in both cases it is the firm's standard practice to arrange that the fuses are remote to the bus-bars so that the switch isolates the fuses for renewal.

80-Watt Fluorescent Lamp

RECENTLY the British Thomson-Houston Company, Ltd., has produced a form of lamp the action of which depends upon the properties of fluorescent materials as they affect light. These materials have the property of changing the wave length of light, and consequently its colour. Moreover, each fluorescent material has the property of changing the wave length of any impinging or transmitted light to one particular value, regardless of the original wave length. It follows that by choosing suitable fluorescent material or mixtures of materials, any desired quality of light can be obtained. The quantity of light actually depends on the wave length of the activating light, and for each material there is an optimum wave length, which so far as a large number of powders are concerned is 2537 Å. The new lamp produces a large amount of light of this wave length, and the purpose of the fluorescent powder which coats the tube is to convert this invisible light into visible light of approximate daylight quality. In Fig. 1 there is shown a diagrammatic analysis of the light from the new lamp compared with that from noon sunlight.

The lamp consists of a glass tube, 5ft. long and 1½in. diameter, coated on the inside surface with a thin layer of a mixture of fluorescent powders. It is filled with argon at a pressure of about one two-hundredth of an atmosphere, and has a small amount

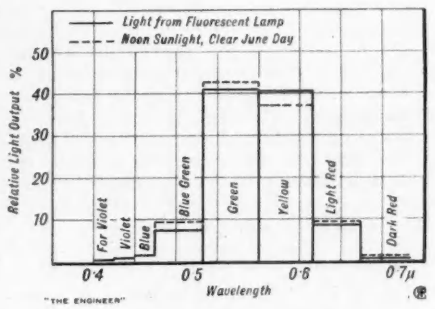


FIG. 1—ANALYSIS OF LIGHT

of mercury. In Fig. 2 the lamp is shown in some detail, together with its electrical circuit. The temperature at which the lamp operates is so low (40 deg. Cent.) that the fluorescent powder can be safely placed on the inner surface of the tube, and no outer jacket is required. Owing to the length of the lamp, it is necessary to heat the electrodes so that they emit a copious supply of electrons and then to give a voltage surge to enable the arc to strike. Once the arc has struck, the current flows freely, and would build up to destructive levels if there were not also in the circuit a choke which functions as a current limiter. The electrodes need only be heated for an instant, and the voltage surge is only required momentarily. Both these requirements are met by means of a starter switch—in this case a thermal switch. On switching on, the current flows through the choke, the heater coil, the electrodes, and the starter switch contact, and back to line. The electrodes are heated and at the same time the heater

coil is heated, which in turn heats the bi-metal of the switch. When the bi-metal has been heated, the contacts break and so cause a voltage surge due to the presence of the choke in the circuit, this surge causing the arc to strike.

The efficiency of the lamp is high, the initial value being 35 lumens per watt, and its brightness is low, since the total light output is evenly spread over a comparatively large area. The brightness figure is about 3 candles per square inch, so that the lamp, if correctly applied, is practically free from glare. Like all discharge lamps, the new lamp is capable of producing a stroboscopic effect, but to a much smaller degree, since the fluorescent powders have some degree of phosphorescence which introduces a certain damping effect. In actual fact the stroboscopic effect is approximately intermediate between that of an incandescent lamp and a standard discharge lamp. Although the lamp has many applications, industrial lighting in present circumstances must take precedence.

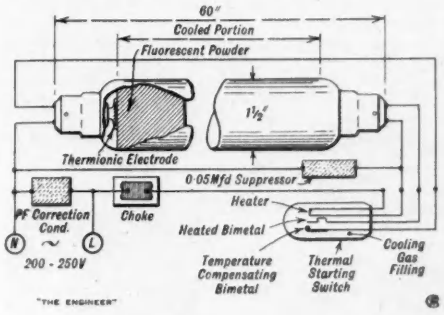


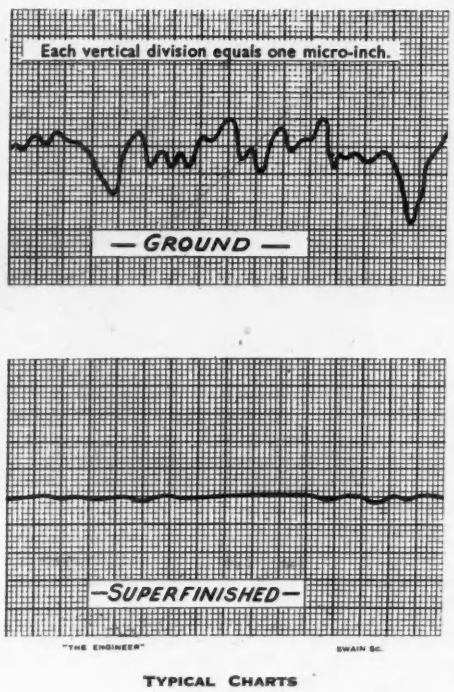
FIG. 2—DIAGRAM OF LAMP AND CIRCUIT

The Brush Surface Analyser

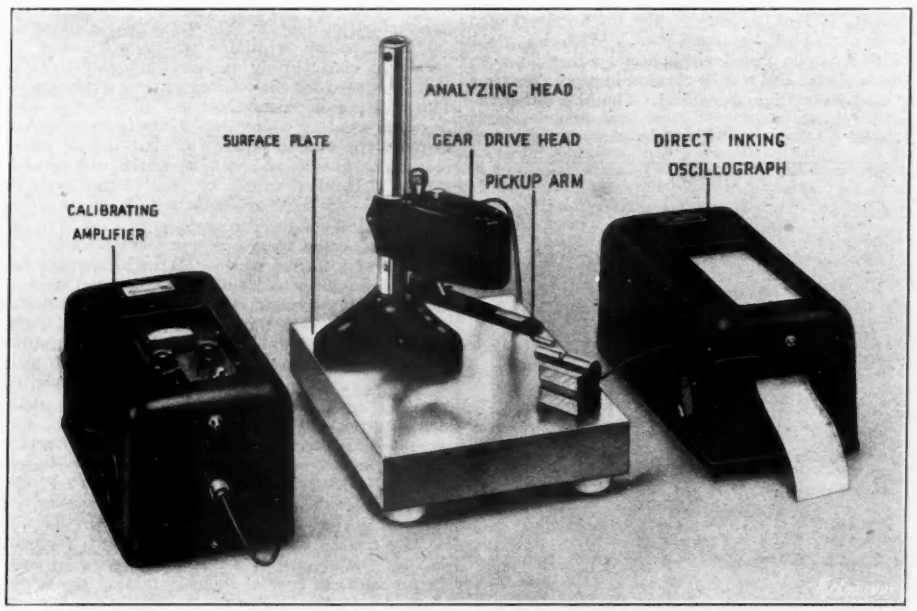
THE Brush surface analyser, illustrated herewith, is designed for rapidly analysing and directly recording the irregularities of finished surfaces of metals, glass, paper, plated and painted surfaces, and the like. It consists of three principal units—an analysing head, a calibrating amplifier, and a direct-inking oscillograph. These three units working in conjunction with one another give an instantaneous and permanent record of the "topography" of a finished surface, the irregularities of which may be magnified as desired up to 100,000 times. This magnification enables records to be made of surface irregularities smaller than one-millionth of an inch, and shows not only their amplitude, but also their form. Absolute measurements are shown without resorting to conversion formulæ.

The analysing head consists principally of a calibrated pick-up assembly, mounted in an arm projecting from a gear drive mechanism. These parts are mounted on a rigid stand, providing both vertical and horizontal adjustment. The stylus used to explore the surface under test is made of sapphire, and has a tip radius of 0·0005in. The motion of this stylus over the surface irregularities is transmitted through a mechanical linkage to a piezo-electric crystal, and the varying pressure generates a voltage between the electrodes of the crystal element. This voltage is directly proportional to the stylus deflection, and is of the order of 0·0015 volt per micro inch of deflection.

The stylus is mounted in a protective tubing which also carries a hardened steel positioning shoe. This shoe locates the stylus in the vertical plane and rides over a relatively wide area of the surface to provide a reference level. The protective tubing for the stylus is mounted at the extreme end of the pick-up arm, which is pivoted in spring conical bearings attached to the gear drive mechanism. The output of the crystal element is connected to the calibrating amplifier by means of a single conductor shielded cable. The drive head contains gearing and cams to impart a rotary motion describing a circle of 0·060in. diameter, and a reciprocating motion describing a straight line 0·060in. long to the stylus. One complete cycle of either motion takes fifteen seconds. Either motion may be selected by means of a knob on top of the drive case. Power for operating the gear drive is obtained from a flexible shaft which connects to the chart motor of the direct-inking oscillograph.



TYPICAL CHARTS



UNITS OF THE BRUSH SURFACE ANALYSER

The two-stage calibrating amplifier is supplied with power equipment which operates from a 110 to 120-volt, 60-cycle A.C. supply. If required a transformer can be supplied to suit A.C. 220–250 volts. The amplifier supplies the magnification between the analysing head and the direct-inking oscillograph. A calibrated step type attenuator is included in the input of the amplifier to provide various degrees of magnification in pen movement of the surface irregularities. A calibrating circuit is included which supplies a "test" voltage for adjusting the magnification of the amplifier to provide any desired deflection on the oscillograph chart. In the most sensitive setting of the amplifier, the deflection on the chart of the oscillograph may be as high as 3 mm. per millionth of an inch stylus deflection.

The output of the amplifier is connected to the direct-inking oscillograph by means of a two-conductor shielded cable. The oscillograph records the irregularities of the surface under test, as picked up by the analysing head and magnified by the calibrating amplifier. It is equipped with a direct-inking pen actuated by a crystal element which is thermostatically controlled for stabilisation. The fluctuations of the pen are recorded on a moving paper chart. The crystal-driven pen is designed for stiffness and low mass, which enables it to respond to rapid fluctuations up to sixty or more vibrations per second. A maximum deflection of approximately ¾in. on each side of the zero axis is obtainable.

The chart feed mechanism is driven by a synchronous motor which, as previously stated, also drives the pick-up travel mechanism. This ensures a constant speed through a gear train providing a selection of any one of three rates of feed. For most purposes it appears that a feed of 1in. per second, corresponding to a linear magnification of approximately 100 times, provides the most easily interpreted chart. Representative charts are reproduced herewith. These charts show the true topography of the surface and not simply the mean departure from a theoretically flat surface.

A surface plate of finely finished cast iron measuring 10in. by 14in. is supplied with the unit. This plate is used to mount the analysing head stand and the work to be analysed. It rests on four rubber mountings to prevent transmission of vibration to the analysing head. The British agent for the Brush surface analyser is A. C. Wickman, Ltd., Coventry.

Price Stabilisation

A SERIES of far-reaching proposals to provide a sound foundation for post-war recovery and a new basis for world economy was made by Mr. L. St. Clare Grondona at a meeting organised by the Institute of Export at the Royal Empire Society yesterday, April 3rd.

As the whole system of world economy is based upon primary production, said Mr. Grondona, there could be no stability in the superstructure of industry and commerce till there was stability at its base. Prior to 1914, because the Bank of England would always buy gold at 77s. 9d. an ounce, and always sell it at 77s. 10½d., the price of gold was stabilised throughout the world. The same principle, he contended, must be applied to a wide range of standard products of constant utility value, such as wheat, sugar, wool, copper and tin.

Bread was as indispensable to man whether its price was 6d. or 10d. a loaf. It was absurd that the price of wheat should average 7s. 6d. a bushel throughout one year and 3s. 4d. throughout another. The price of sugar had been up to 25s. 9d. per hundredweight and down to 4s. 8d., of wool 6s. 4d. per pound down to 1s. 10d., of tin £300 a ton down to £118, and of copper £118 a ton down to £30. These were not freak figures; they were officially recorded annual average prices of recent years.

It was manifestly impossible to keep industry and commerce on an even keel in such circumstances, and the results had been distress beyond measure which would recur after this war unless counter measures were taken. Though the problem had baffled the world, its solution was disconcertingly simple, said the speaker.

Mr. Grondona's plan is that the British Government should establish a Price Stabilisation Corporation to operate in relation to all the chief non-perishable products in the same manner as the Bank of England used to operate in relation to gold. A fair average price (to be known as the datum line) would be established for each product and the Corporation would buy at a price, say, 10 per cent. below the datum and thereafter sell at 10 per cent. above datum.

If 5s. a bushel was fixed as the wheat datum, the Corporation would then be a buyer at 4s. 6d. and a seller at 5s. 6d., and open market fluctuations would thus be limited to 1s. a bushel. Obviously the Corporation could not sell until it had reserves, but it would establish these so soon as there was a surplus manifested by a 10 per cent. fall below acknowledged fair average price. The datum could be altered, but only after at least a year's notice had been published.

All grains, pulse, nuts and seeds, textile and fibrous raw materials, oils, fats and waxes, industrial metals and many other products of standard utility value—whatever their source—would come within range of the scheme. While the primary producer would be safeguarded from the outset, the interests of the wholesale consumer would be correspondingly protected so soon as reserves were in Corporation ownership.

To enable tariffs and preferences to be maintained all Corporation depôts would be bonded stores, but under this system exports of products out of reserves would be unhampered and the Corporation would

sell to all nations on the same terms. To foster home production bounties (as for wheat and sugar) could be continued as heretofore.

Mr. Grondona urged that the Corporation should be set up without delay for the purpose of establishing reserves in several overseas primary producing countries in which surpluses were now accumulating owing to loss of European markets. Most of these countries were debtors to Great Britain in sums aggregating nearly £3000 million before this war. All such securities were now controlled by the Treasury, and the proposed Corporation should be empowered to negotiate an exchange of a proportion of such bonds for local currencies with which to pay for primary products bought into reserve.

The goal arrived at was that this country should acquire at least £500 million worth of such products as would be in unprecedented demand here and in Europe after this war. Great Britain would thus be in a position to make loans available in kind to hasten our own and Europe's recovery, and the Corporation's ownership of such vast stocks would enable it to control the range of future price movements within reasonable limits.

Mr. Grondona next went on to show how his plan would apply with equal effect to many manufactures of standard grade and constant utility, such as piece goods of many sorts and various types of iron, steel and other metal goods, as well as to paints, chemicals, fertilisers and many other commodities. He suggested that each should have its own datum line and that the Corporation should be ready to buy at a price 10 per cent. below this and to sell 10 per cent. above it.

By such means, he contended, a wide range of secondary industries would be maintained constantly in full production of goods that were of real utility to this nation and to the world; and the purchasing power of all engaged in these industries would be kept at a uniformly high level.

The speaker's final contention was that, just as all great nations in the past had adopted the gold standard in line with Great Britain, they would in due course all adopt the price stabilisation plan, which was wholly beneficial and not inimical to any legitimate interest, national or international.

This would mean that ultimately all currencies would be exchangeable for known quantities of standard utility products and, at that stage, there would be stability in foreign exchange to almost the same extent as when all great nations were on the gold standard.

Tank-Tractors for Sewage Sludge

REMOVAL of sludge from sand drying beds to the place of deposit or disposal is a problem at many American sewage treatment plants, there being a difficulty in having the work performed efficiently and economically and without disturbance of the sand bed. The dried sludge is usually picked up by men with tools like large stable forks, and may be loaded into motor trucks or into small tip wagons on narrow-gauge tracks of a portable railway type, the cars being pushed and dumped or tipped by hand.

FIG. 1—LOADING TANK-TRACTOR

An innovation was introduced at the municipal plant at Springfield, Illinois, to replace the original plan of using trucks travelling on runways or wheelways consisting of heavy oak planks. The placing and removing of these planks entailed considerable time and labour, and when the trucks occasionally ran off the planks the sand beds would be cut up to a serious extent.

In considering the improvement of these unsatisfactory conditions, Mr. W. B. Walraven, Superintendent of the Springfield Sanitary District, had estimates made for the cost of an industrial or portable railway system and its equipment, and also of fixed runways composed of concrete wheelways or steel channels for motor trucks. The first of these plans appeared to be the most suitable, but before a decision was made a suggestion for the use of a crawler type of petrol tractor fitted with side tanks or bins was submitted by the Allis-Chalmers Manufacturing Company, a manufacturer of tractors. A definite design was then made for a machine fitted with two bins having a combined capacity of nearly 3 cubic feet. Side doors hinged at the top and operated from the cab by levers would discharge the contents of the bins.

This design was adopted and at least three sewage treatment plants now handle their dried sludge in this way. In the accompanying views Fig. 1 shows the loading of the bins; Fig. 2 shows the bottom side doors open to unload the sludge. These machines are about 8ft. long, 7ft. wide overall, and 6ft. high to the top of the exhaust pipe, while the tops of the bins or bunkers are 3ft. 6in. above the ground. The petrol engine is rated at 33 H.P. and is geared for four forward speeds of 2½ to 6 miles an hour, and a single speed of 2½ miles an hour in reverse.

The total weight approximates 6500 lb. light or 8000 lb. with bins full. With a bearing surface of 1353 square feet for the crawler tracks, the load upon the sand beds is about 5 lb. per square foot with the bins empty, or 7⅛ lb. to 10 lb. per square foot with a full load of nearly 3 cubic yards of sludge, the weight of which varies according to its moisture content. Experience with the machine, as reported by Mr. Walraven, is that it causes very little disturbance or compacting of the sand bed. With its great mobility it can be placed within easy loading distance, so that a sludge bed can be cleaned in much less time than under the original method. The bins dump the loads freely, and the sludge forms windrows on either side. When the disposal area is filled, the tractor is run on top of the sludge and begins placing windrows for a second layer of sludge. The bins are easily removable, so that the stripped tractor is available for other work around the plant. Three men can remove the bins in about thirty minutes, and can replace them in a little longer time.

In connection with the enlargement of the sewage treatment plant at Aurora, Illinois, the question arose whether to extend the existing narrow-gauge industrial railway system to the new sludge drying beds, or to introduce some new system. After study of the situation and estimates of cost, a plan for the use of the "tank tractor" machine was worked out by Mr. Walter A. Sperry, Superintendent, and Mr. Walter Deuchler, Engineer, of the Aurora Sanitary District. The railway tracks and equipment would have cost some £750, while the tractor complete cost only £500. Besides this direct saving, the tractor method was more economical in operation and reduced the labour cost considerably. There were further advantages in that the tractor served for various purposes around the plant, such as removal of grit from the grit chambers, clearing snow from the driveways, and levelling off the surface of the sludge pile with a bucking board or bulldozer attached to the front end of the machine.

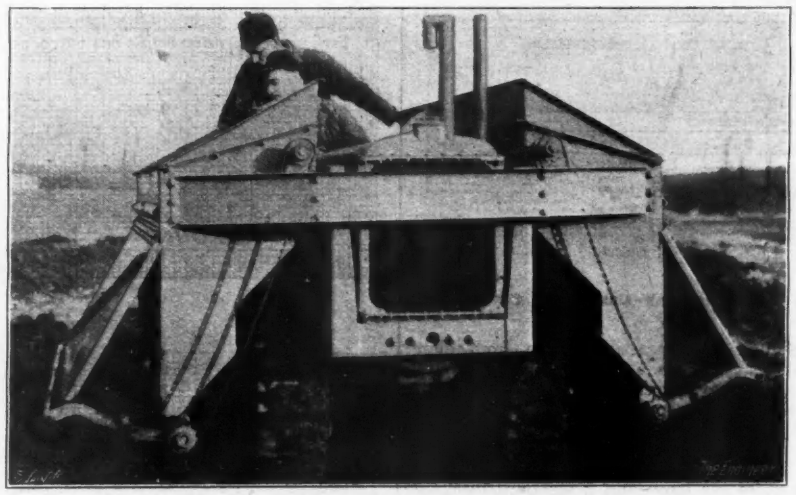


FIG. 2—SIDE DOOR TIPPING

American Engineering News

American Combustion Turbine Locomotives

THAT the reciprocating internal combustion engine will be followed by the combustion turbine, even as the reciprocating steam engine has been followed by the steam turbine, is the opinion presented in a recent report to the American Railway Fuel Association. Combustion turbines are being built for the oil-refining industry and other purposes, and plans have been drawn up for a 500 H.P. combustion turbine locomotive. For the turbine blading there are alloy metals available which will stand temperatures considerably higher than the 1000 deg. Fah. now used for the combustion gas to the turbine. This will permit economical use of higher pressures from the axial air compressor to the turbine, and thus increase the overall efficiency. In view of possible reductions in size and weight, which will permit of a 6000 H.P. plant in one locomotive unit, plans are being made for such an engine, with four gas generating units and combustion turbines of 1500 H.P. each. Each unit would form a power plant for one of the four pairs of driving wheels, each transmission being made through an hydraulic converter and hydraulic coupling. It is explained that this arrangement would give three times as much power per driving axle as can be used on an oil-electric locomotive, because an electric motor of 500 H.P. is about as large as can be placed in the space available. Thus for 6000 H.P. the oil-electric engine would require twelve pairs of driving wheels in three units with three cabs, with a weight of 470 tons, as against 250 tons for the combustion-turbine locomotive of the same power. The latter would also haul more cars in the train, as a result of its lighter weight. It would use nearly twice as much fuel oil as the oil-electric engine, but the oil would be of a quality costing only half as much per gallon, so that the net result would be a saving in cost of 25 per cent. in cost of fuel oil, taking into account the heavier train hauled.

American Locomotive Working

That waste of fuel still exists and that there are methods of further reducing it was the thesis of a paper read at the annual meeting of the American Railway Fuel Association. Engines sent out from the running shed should be in proper working order, supplied with the proper quality of coal and with tender not overloaded so as to spill coal. A train should be ready when the engine is called for, or fuel is wasted while the engine is kept waiting. Stopping through trains to take coal and water is another cause of waste, and may be reduced by increasing the fuel and water capacity. By using larger tenders, or using one tender for coal and another or a tank car for water, some railways have eliminated as many as three stops on a through train run. Dispatchers also

can arrange to start heavy through goods trains at times when they will encounter the least traffic interference. A study of fuel loss and waste under various causes indicated that a saving of 12 to 14 per cent. could be made by remedying the various causes. Mechanical cleaning of coal is highly desirable from the standpoint of both efficiency and economy. On ten railways in 1940 the average miles run per passenger locomotive per day ranged from 199 to 286, while freight engines averaged from 96 to 130 miles per day, and shunting engines averaged from 64 to 80 miles per day. The length of run is but a minor factor affecting the monthly mileage performance, and many railways are obtaining high mileages with turn-around runs. Oil-electric locomotives in passenger service make about 40 per cent. more monthly mileage than steam locomotives.

Military Water Purification Plant

A portable plant for the pumping and purification of water for supplying troops in the field has been devised by American Army engineers. All that is needed is a stream, reservoir, or other source of water of adequate capacity. Its situation and the quality of water are negligible factors, the plant being capable of furnishing a clean and safe supply of water, up to 180,000 gallons per day. This plant consists of two units. The first comprises a pump with petrol engine, a hypochlorinator, a hypochlorite solution tank, and chemical feed for simultaneous application of two kinds of water treatment chemicals, such as alum and soda ash. The second section consists of a complete filter plant, with all accessories. Everything is contained in two motor vehicles, and is designed for rough handling and compact packing. The pump is of the self-priming open-impeller centrifugal type, with the impeller on the extension of the engine crankshaft. It can deliver 55 gallons per minute against a head of 50ft., including a suction lift of 15ft. The hypochlorinator consists of a belt-driven geared unit and diaphragm assembly capable of pumping hypochloric solution at the rate of 10 to 50 gallons per twenty-four hours. It will provide a residual chlorine content of one part per million in the water after ten minutes of rest or storage. In the filter unit the filtering medium consists of an 18in. bottom course of gravel and a 4in. top course of quartz sand. This pumping and purification plant carries a complement of three men, all capable of operating both the chemical and mechanical features of the treating process. A practical demonstration was given of the effectiveness of this portable plant when a town of 6500 people was flooded and its waterworks overwhelmed. In the emergency, the Army engineers sent one of these portable plants which was in service within a few hours, and delivered 110,000 gallons daily of pure potable water.

BRITISH STANDARDS INSTITUTION

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.

DEVICES FOR THE DETECTION OF INCENDIARY BOMBS

B.S./A.R.P. 53. It is obvious that any means that will assist in preventing the development of fires caused by incendiary bombs will not only relieve hard-pressed fire brigades and save valuable property, but will also reduce or eliminate illuminated targets for subsequent enemy bombers. One such means is to ensure that the presence of an incendiary bomb is detected as soon as possible, and with a view to assisting in the development of satisfactory systems for the detection of incendiary bombs a memorandum has been published by the Institution of Electrical Engineers in the form of a report by the Committee which was set up at the request of the Ministry of Home Security.* The report points out that there are several different principles on which the detection system can operate, such as the impact of the bomb as it hits the roof or other obstruction, the sound caused by the arrival of the bomb, the light emitted by the bomb, the products of combustion, or the heat given out by the bomb. The Ministry of Home Security has initiated certain experimental and research work in order further to ascertain the capabilities of some systems of fire detection.

This specification deals with fire detectors of the heat-sensitive type. It will in due course be followed by specifications for other types of detector. The specification for heat-sensitive detectors is designed to ensure the reliable performance of devices which cause an electric alarm to be sounded either when the fire causes the temperature to rise to a certain value, or when the temperature rapidly increases. Such devices include thermostats (temperature-operated switches) and devices which operate by virtue of the melting of an alloy or wax, or by the expansion of a liquid. The method of testing the detector is defined and notes are given on the selection, installation, and maintenance of detection systems. Copies of the specification may be obtained from the British Standards Institution, price 4d., post free, and copies of the Memorandum on Fire Detection Devices may be obtained either from the British Standards Institution, or from the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, price 6d., post free.

* A review of this report was published as a Journal note in our issue of Februar 21st, 1941.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

The United States Steel Industry

The steel industry in the United States would appear to be experiencing somewhat similar conditions to those ruling in Great Britain. Recently, the American Government pressed the steel industry for an increase of 10 million tons per annum in steel making capacity. The industry indicated that it considered this unnecessary and a survey of the position was made. This resulted in a statement being issued at the end of February that the steel making capacity of the United States in 1941 would be 87,576,100 tons, which was 3,500,000 tons more than the industry estimated at the end of last December. By the end of this year additional plant under construction will increase the productive capacity of the works to 91,124,718 tons. On the other hand, it is estimated that the consumption of steel in 1941 will total at least 77,500,000 tons, made up of 61,000,000 tons for ordinary commercial requirements, 3,100,000 tons for the American defence programme, and 13,400,000 tons for export. The last item, it is thought, refers principally to exports to Great Britain and Canada. A somewhat stringent position has developed in the pig iron market at Pittsburg. All the blast-furnaces owned by the steel works are engaged upon steel making irons, which are being absorbed as fast as they are being produced. The ironfoundries have to depend upon merchant furnaces and the latter are finding it difficult to meet the demand. No rigid system of priorities has been instituted but a system of concessions between buyers appears to have worked well. Labour difficulties have had an adverse effect upon production, although in the majority of cases they have not lasted for long; but it is thought possible that they may influence prices for the latter part of the year. Quotations for the most commonly used alloys have been fixed for the second quarter at the levels previously ruling and there is a suggestion that the pig iron makers in the national interest should maintain their prices also. This, however, will depend upon the result of negotiations which are being carried on between the bituminous coal miners, the coalowners, the labour organisation and the United States Steel Corporation.

The Pig Iron Market

No important change has occurred for some time in the pig iron position. The production of high-phosphoric foundry iron, which is principally used by the light castings makers is on a scale sufficient to supply the full requirements of this industry. The light foundry trades, however, are generally working at below capacity, and although there has been some improvement lately in the demand for their products it is only of a moderate character, but is sufficient to result in a better demand for foundry irons. These furnaces now draw their supplies almost entirely from the Midlands, and are obtaining all the pig iron they need. The position in this department is distinctly good and some of the producers are reported to have been able to accumulate stocks. On the North-East Coast the production of foundry iron is of insignificant proportions, and consumers in this area also draw their requirements from the Midlands. A satisfactory feature of the situation is the improvement in the transport position, and delays, which were frequent early in the year, have now been overcome. The heavy engineering foundries have been fully employed for months, but lately there has been a speeding up in several departments, so that larger quantities of pig iron have been asked for. For the most part these foundries use hematite and low-phosphoric iron, and there is more stringency in these than in other classes of iron. As a result the Control is exercising considerable care in the distribution, and firms not engaged in essential work have as a rule to use different qualities from those they normally take. Imports of hematite iron have been arranged and these are distributed to consumers who urgently need supplies. The general impression prevails that although there may be some tightness in the position the supplies of this iron are more satisfactory now than they were at the end of last year. The cost of imported iron is higher than the fixed British price, but the consumer is involved in no extra charge as the difference is met from the central fund allocated for this purpose.

The Midlands and South Wales

The outstanding feature of the market is the persistent way in which the demand for all classes of steel is maintained. The steel works generally are operating at capacity and the position is continually under review with the object of putting fresh plant into operation if possible. Munition works continue to absorb large tonnages of steel, whilst engineering establishments of all kinds are engaged upon Government work and are taking up steel in increasing quantities. The latter generally come under the high priority classes. The constructional engineers are fairly busy, but are specifying for much smaller quantities than earlier in the year. The demand from this source is principally for the lighter joists and sections, and the heavier descriptions are not in such urgent request. There is no relaxation in the pressure on the part of consumers to obtain plates, and the demand from the shipbuilding industry is particularly strong, although the boiler and locomotive builders and tank makers are also large buyers. The call for bars is active, principally from the engineering works. Recently there has been a particularly strong demand for the smaller bars, but the rollers of large bars have full order books and are likely to be busy for some months. A considerable quantity of imported iron and steel has been distributed of late, but even so the requirements of firms employed upon ordinary commercial work and works manufacturing for export are relegated to the background. The shipbuilders and ship repairers, of course, come amongst the high priority classes and their requirements are being met fully. In South Wales active conditions continue to rule and the production of steel is maintained at a high level. The output is absorbed almost entirely by requirements arising out of the war and it is not easy to obtain finished steel material for ordinary commercial purposes. The heavy steel makers have a large tonnage of orders in hand, a good proportion of which is for material needed by the shipyards.

Copper and Tin

The British copper position has not changed and supplies are equal to the requirements of the national effort. A certain amount of copper appears also to be available to meet the needs of manufacturers making exportable products, such as copper sheets. According to a publication of the Queensland Government, the copper position in Australia is tight owing to the large tonnages required as a result of the expansion of the Australian munitions production. The output of copper in Australia last year was about 19,500 tons, which is almost a record. In the United States the copper market has maintained a firm tone. The domestic price is unaltered at 12c. and the export price at 11c. to 11¼c. There is a vigorous domestic demand and it is understood that of the recent purchases of copper from Latin America, 35,000 tons has already been distributed. It is also expected that a large portion of the remainder will be consumed during April. Practically no copper has been exported from the United States except to British Empire countries and to some South American countries. There have been some inquiries from Sweden, but the execution of these, of course, will depend upon the ability of the buyers to obtain "navicerts." It is suggested that the position as regards Sweden is somewhat difficult, since while she might not supply Germany with copper, she might barter copper in manufactured forms to Germany for materials required in the country. The United States February exports are given as 9755 tons, of which England took 2185 tons. Japan received the largest quantity of 6113 tons, whilst 859 tons went to China and 100 tons to Kwantung. Mexico took 330 tons and 100 tons was exported to India, leaving only 68 tons to various other destinations. . . . The tin market has developed a somewhat quieter tone, largely because the brisk demand from the United States has fallen off. As a result, after advancing prices this week have shown a tendency to decline. Another reason has been that it is understood that the Ministry of Supply has sold nearby tin and bought forward. The Department might be actuated by two reasons: first, the sales would have the effect of keeping the price down to moderate levels, and secondly, by buying forward stocks would be maintained and warehousing risks and expenses avoided. The British tin position appears to be satisfactory and there is little doubt that most of the consuming works have a certain amount of tin available for use in an emergency.

Lead and Spelter

The lead situation in Great Britain remains comfortable and there is no shortage of either virgin or scrap metal, so that consumers are usually able to get their full requirements. In the United States the price is held at 5·85c., New York, but there is no metal available for export and no export price is quoted. The domestic demand is active, but supplies are sufficient to meet the needs of consumers and the American authorities do not appear to be so concerned in keeping the price of lead down. Probably they consider that lead is cheap when compared with other non-ferrous metals. It is argued that the American lead position is satisfactory and that there is no likelihood of any shortage in spite of the expansion in demand due to the American defence programme. This is largely because the United States could at need draw upon large Mexican resources. . . . Although the spelter position in Great Britain remains tight, consumers engaged upon essential national work are receiving all the metal they need. The Control is carefully supervising distribution and most of the licences issued are for prompt delivery. Considerable tonnages are passing into consumption and the consuming trades, particularly the brassmakers, are fully employed. It is expected that supplies of brass will be imported from the United States shortly, which may relieve the pressure by consumers who are anxious to obtain spelter. In the United States the spelter position is tighter than in any of the other non-ferrous metals, but the price remains unaltered at 7·25c., East St. Louis. Stocks are not large and, in fact, are regarded as being at a dangerously low level; but before the end of the year a considerable increase in productive capacity will come into operation and this should change the position. There is no spelter available for export in the United States. India has been in the market, but has been unable to secure the quantities required.

Non-ferrous Metal Prices

The London Metal Exchange official statement for March indicates a rise in the average quotations for tin of £5 2s. for cash and £4 10s. 9d. for three months, compared with the February average. The settlement average is £5 3s. 8d. above that for the previous month. The statement, which includes the official maximum prices for copper, lead, and spelter is as follows:—

Standard tin	Cash (mean)	£270	5 10
	Three months (mean) ...	£268	10 4½
	Settlement	£270	6 5½

The following prices for copper, lead, and spelter are the maximum prices fixed by the Controller of Non-Ferrous Metals:—

	£	s.	d.			
Standard copper		—				
Electrolytic copper ...	62	0	0	delivered	buyers'	premises
Electrolytic wire bars ...	62	0	0	,,	,,	,,
Best selected copper ...	60	10	0	,,	,,	,,
Lead, good soft pig ... (foreign)	25	0	0	,,	,,	,, (duty paid)
Spelter, G.O.B. (foreign)	25	15	0	delivered	buyers'	premises (duty paid)

Notes and Memoranda

Rail and Road

SPLINTER-PROOF GLASS.–There is considerable difference of opinion about the utility or otherwise of glass treated to reduce splintering. The chairman of the L.M.S. Railway disclosed at the general meeting of shareholders the finding of the company's research department. It was that it had been found possible so to treat the windows of signal-boxes, without interfering with clear vision, as to ensure that not a single man had been injured by glass splinters. In one case the signalman was literally wrapped in glass without being scratched.

RAILWAY RESEARCH IN INDIA.—An organisation on permanent lines is being set up in India for research under the Chief Controller of Standardisation Railway Board. The personnel will include three officers for general research and one dynamometer car officer. A programme embodying thirty-six items calling for early investigation has been prepared. The subjects include such practical topics as the strengthening of coach bodies, effectiveness of passenger communication, and development of leak-proof wagon roofs and doors.

TO TRANSPORT CEMENT.—The American Car and Foundry Company, after an exhaustive study of covered hopper-car designs, has introduced a car having greater earning capacity than existing designs. It is to be used for the transport of cement, which, as it is blown into the car at the loading position, weighs about 80 lb. per cubic foot because of the air trapped in it. During the loading operation, a portion of this air escapes as the cement settles, and before the car has travelled very far a sufficient portion of this air will have escaped and the cement settled so that it has a density of from 92 lb. to 96 lb. per cubic foot. The car has a cubic capacity of nearly 81 tons.

PRODUCER GAS FOR HEAVY VEHICLES.—Mr. John F. Heaton, the chairman of the Tilling transport interests, has recently explained what his company has done to further the use of producer gas as an alternative fuel. A year's research and experimental work had been so productive that a decision had been made to operate one depôt—though not yet a large one—entirely on producer gas vehicles. The experience so gained should lead to further improvements. The scientific side of producer gas propulsion was being conducted on behalf of the Tilling companies at the Mining Department of Birmingham University under the direction of Professor Neville Moss and Dr. S. Ward.

L.M.S. PAPER RECLAMATION SCHEME.—By setting up the first stationery reclamation depôt in the country, the L.M.S. Railway is reclaiming used paper and envelopes at the rate of 100 million pieces a year. So successful has this effort already proved that the company is opening a second reclamation depôt in Glasgow, which will cover the whole of Scotland. The London depôt employs over fifty women workers who sort, classify, and parcel-up the material sent in from sixty-five salvage centres on the L.M.S. system. Nothing that goes into the reclamation depôt is wasted. All pins, paper clips, and binders are taken out and sorted, more than a hundredweight of pins alone being recovered each month, whilst about 3 tons of scrap paper not suitable for re-use is sold monthly, apart from the large tonnage of waste paper collected all over the system for repulping which, in 1940, totalled over 3000 tons. Apart from reclaiming used paper, the company is achieving considerable paper economy by reducing the number and dimensions of the numerous forms required for railway business.

Air and Water

SHIPPING LOSSES.—Mercantile losses by enemy action for the week ended March 24th were ten British ships amounting to 24,940 gross tons, six Allied ships amounting to 27,528 gross tons, and one neutral ship of 6673 gross tons. The total tonnage lost was therefore 59,141.

GOLDEN GATE BRIDGE NET.—Parts of the safety net made of manila rope which was first used successfully under the Golden Gate Bridge at San Francisco, and is now let out to jobs where special safeguards are desired for steel workers, are once again in service, this time on the high trestle for concrete placing equipment of Friant dam.

INDOOR AIR RAID SHELTERS.—The Ministry of Home Security has stated that no fewer than 111 firms are manufacturing the parts of the Morrison indoor air raid shelter. Fifty-one are turning out pieces of the framework and the tops, six the side panels, thirty-six are working on various other parts, while eighteen are making the necessary bolts and nuts. Other firms are manufacturing the spanners and hooks required to fix the parts together.

OHIO RIVER FLOOD WALL.—Construction of a flood wall along the Ohio River, near Portsmouth, Ohio, is expected to be started in the near future. The structure will be a reinforced concrete wall, approximately 4000ft. long. The materials required include more than 3,000,000 lb. of reinforcing steel, steel sheet piling, and miscellaneous metal; also 19,950 cubic yards of concrete, six sluice gates, and eight movable gate closures. The work is to be completed within 275 days from date of contract.

"RAID SPOTTERS' POCKET BOOK."—We have received from Charles Letts and Co. a copy of a "Raid Spotters' Pocket Book and Log," which has been produced with the object of assisting the novice and broadening the outlook of the experienced on the subject of raid spotting in all its aspects. The book contains detailed information on aircraft identification, British and enemy; particulars of parachutists' uniform and weapons; hints on visual and sound spotting, including some remarks on the use of binoculars. There is also a useful angle graph, and some general information regarding bombing angles, war gases, and fire-fighting, as well as some notes and illustrations on cloud formation. The price of the book is 1s. 6d.

WATER INTAKE AT CARRUTHERS POINT.—A contract for the construction and installation of a water intake at Carruthers Point, on Lake Ontario, to provide cold water all the year round for the new nylon plant of Canadian Industries, Ltd., has been awarded to the Canadian Dredge and Dock Company, Toronto, at a cost of approximately 30,000 dollars. According to *Contract Record*, this intake will consist of a pipe line laid from the pump house near the shore into deep water, a distance of approximately 1900ft., and water will be obtained from a depth of about 80ft. to ensure a continuous supply.

Miscellanea

MOLYBDENUM-TUNGSTEN MINES IN RUSSIA.—Extensive molybdenum and tungsten workings have been opened in Kabardino-Balkaria, in the Caucasian Mountains, at the foot of Mount Terny-Auz. Discovered some years ago, it is only recently that modern mining equipment has been installed.

CHROMITE FROM TURKEY.—The production of chromite in Turkey, which amounted to 3400 tons in 1924, rose to 208,405 tons in 1938 (figures only recently released). The output came mainly from the Guleman mines (Ergani Maden), which are said to be the most extensive chromite deposits in the world.

A BRITISH NYLON WORKS.—Mr. Samuel Courtauld has informed his shareholders that British Nylon Spinners, Ltd., in which his company is interested, has started production, although "there is little likelihood of much of it being available for some time to come." Promising methods of finishing staple fibre to make it suitable for fabrics of wool-like character are under development.

MOLYBDENUM FROM SWEDEN.—An important deposit of molybdenum in Sweden was discovered recently at Algruvan. The Government Testing Institute at Stockholm reports that the ore has a molybdenum sulphide content of 4·8 per cent. The deposit is fairly extensive and easily accessible. Arrangements have been made to install machinery, and mining operations are expected to begin soon.

THE WOOLINDRAS PROCESS.—This is the term used to describe a process devised for the Wool Industries Research Association of Australia. It follows a recent proposal by the Australian Wool Board that the Commonwealth Government should be asked to stipulate that all woollen clothing provided for the Fighting Forces be made unshrinkable. An experimental plant has been put down to work the process.

THE MAY LECTURE.—The Institute of Metals has arranged to hold its May Lecture out of London. Dr. F. Simon, Reader in Thermodynamics at Oxford University, will deliver the lecture of the Institute at Oxford on May 28th. It will be entitled "The Significance of Low Temperature Research," and will deal with Dr. Simon's own recent experimental work on the properties of matter at the very lowest temperatures.

PLATINUM IN ALASKA.—According to preliminary estimates of the U.S. Geological Survey, the Alaska production of platinum metals in 1940 amounted to 28,860 fine ounces, a considerable increase on previous years. The results put Alaska among the four or five largest platinum-producing countries in the world. The great bulk of the output comes from mines in the Goodnews district, near the mouth of the Kuskokwin River, in south-western Alaska.

ANTI-FREEZE LIQUIDS.—Specification (No. 1-G P-8-1940) for Anti-freeze Liquids, Types I and II, of the Canadian Government Purchasing Standards Committee, applies to water-soluble liquids suitable for use in the cooling systems of internal combustion engines at winter temperatures. Type I comprises those anti-freezes of which an effective constituent is substantially more volatile than water. Type II is made up of those in which no constituent is substantially more volatile than water.

FLOATING POWER PLANT.—Interest in national defence being what it is, says the *Scientific American*, the thoughts of A. P. Kellogg, General Electric turbine engineer, have turned to the question of floating power plants. Recently he made designs of a 50,000-kW floating power station, which may be constructed as part of the national defence programme. In the event of the generating facilities of a city of 150,000 to 200,000 being destroyed by bombs, this power plant would, in a short time, be towed to a nearby spot and hooked into the town's electrical distribution system.

BLAST-FURNACE CEMENT.—Replying to a question, Mr. G. Hicks, the Parliamentary Secretary to the Ministry of Works and Buildings, reported tentatively on the work of the technical committee set up by his Department to inquire into the possibility of the use of blast-furnace cement. The report was unanimous on all major questions. The necessary Treasury sanction had been obtained, and the work was now in hand. There was disagreement as to the relative values of some of the available slags. That was a matter which could only be settled by further investigation.

AN INDUSTRIAL MUSEUM.—Stockholm has recently welcomed the completion of the new building of the Tekniska Museet, opened to the public a short time ago and erected with money contributed by Knut and Alice Wallenberg Foundation. Many industrial companies and private persons have aided the project financially and with gifts towards the collections. Swedish engineering and science will be adequately represented by such names as Polhem, Swedenborg, Celsius, Rinman, Angstrom and others of pioneer days; John Ericsson, Carlund, Nobel, De Laval, Wenstrom, Brinell, whose busts will find a place in the Hall of Fame. One outstanding exhibit is an original tower clockwork shown running, designed and built by Polhem. It was moved to the museum from St. Mary's Church in Stockholm, where it had been running from 1765 to 1910, and still keeps time.

SWARF BREAKERS.—Swarf, particularly the kind produced when turning or drilling steel, takes the form of long curled strips. These spirals often become difficult to handle, and if much of this coarser swarf has to be dealt with it is desirable to have it broken up. Mr. D. F. Galloway, in a recent issue of the *Machinist*, described two machines for breaking up the massed metal. The smaller consists of a series of rotating breakers, the teeth of which pass between the teeth of a stationary cutting comb. The swarf is carried between the rotating breaker teeth, past a fixed comb which regulates the feed to the cutting comb. The position of the cutting comb is adjustable by a hand wheel to suit the size and condition of the chips.

Personal and Business

HOWARD HUMPHREYS AND SONS, of 17, Victoria Street, Westminster, inform us that they are now operating from 7, Eldon Square, Reading, Berkshire. Telephone number, Reading 3981.

PROFESSOR E. L. E. WHEATCROFT is shortly resigning the Chair of Electrical Engineering at Leeds University to take up an appointment with Messrs. Merz and McLellan, consulting engineers.

UNITED STEEL COMPANIES, Ltd., announce that Mr. N. Rollason has been appointed managing director in succession to the late Mr. C. J. Walsh, and that Mr. R. Summers and Mr. A. Macdiarmid have joined the board of directors.

MR. R. J. LOW, M.I. Chem. E., A.M.I. Mech. E., late chief engineer of Howards and Sons, Ltd., Ilford, has joined Fredk. Boehm, Ltd., and is now acting in a similar capacity for Messrs. Boehm and their associated companies.

THE Minister of Shipping has appointed as Regional Representatives Sir W. Reardon Smith for the Bristol Channel ports; Mr. J. R. Hobhouse for the ports from Holyhead to Silloth; and Mr. J. C. Denholm for the Clyde area.

DR. C. H. DESCH, F.R.S., Past-President, has been awarded the Institute of Metals Platinum Medal for 1941. The medal, which is placed yearly at the disposal of the Council by the Mond Nickel Company, Ltd., is awarded "for outstanding services to the non-ferrous metal industries." Previous recipients include Sir William H. Bragg, Sir Harold Carpenter and Dr. Paul D. Merica.

THE Council of the Iron and Steel Institute announces that it has decided unanimously to award the Bessemer Gold Medal for 1941 to Dr. T. Swinden, of the Central Research Department, The United Steel Companies, Ltd., in recognition of the value of his original investigations in the metallurgy of steel, and of his eminent services in the organisation and direction of research in the steel industry.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Illuminating Engineering Society

Tuesday, April 8th.—E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2. "The Measurement or Gauging of Low Values of Illumination and Brightness," J. W. T. Walsh; and "Visibility by White and Coloured Light," J. S. Dow. 2.30 p.m.

Institute of Fuel

Wednesday, April 30th.—Royal Victoria Station, Sheffield. "Research and the Coking Industry," E. W. Smith. 2.30 p.m.

Institution of Automobile Engineers

Saturday, April 5th.—LONDON GRADUATES: 12, Hobart Place, S.W.1. "Aero-engine Cooling," C. D. Carmichael. 3 p.m.

Tuesday, April 8th.—12, Hobart Place, S.W.1. Annual general meeting. 4.15 p.m.

Institution of Chemical Engineers

To-day, April 4th.—Connaught Rooms, Great Queen Street, W.C.2. Annual meeting. Presidential address, "Some Post-war Problems," F. H. Rogers. 11 a.m. Luncheon, 12.45 for 1 p.m.

Institution of Electrical Engineers

To-day, April 4th.—N.E. STUDENTS: Neville Hall, Newcastle-upon-Tyne. "Measurements with the Cathode Ray Oscillograph," B. C. Robinson. 6.15 p.m.

Saturday, April 5th.—N. MIDLAND CENTRE: Hotel Metropole, King Street, Leeds. "The Control of the Domestic Load," P. Schiller. 2.30 p.m.

Junior Institution of Engineers

To-day, April 4th.—39, Victoria Street, London, S.W.1. "Some Historical Bronze Castings," R. Lowe. 6 p.m.

Friday, April 18th.—39, Victoria Street, London, S.W.1. "Fittings and their Effect on the Efficiency of Supply Lines," S. J. Moore. 6 p.m. SHEFFIELD SECTION: Metallurgical Club, West Street, Sheffield. Discussion evening. 6.30 p.m.

Saturday, April 26th.—Holborn Restaurant, High Holborn, W.C.1. Luncheon. 1 for 1.30 p.m.

Keighley Association of Engineers

To-day, April 4th.—Victoria Hotel, Keighley. "Melting and Casting Problems in the Production of High Strength and Special Duty Alloy Cast Irons," A. E. McCrea Smith. 7.30 p.m.

Liverpool Engineering Society

Wednesday, April 9th.—The Temple, Dale Street, Liverpool. Annual general meeting. 1.45 p.m.

Newcomen Society

Wednesday, April 23rd.—Inst. of Structural Engineers, 10, Upper Belgrave Street, S.W.1. "Megalithic Ruins at Cuzgo, Peru," C. O. Becker; and "Cast Iron in Building Construction," S. B. Hamilton. 2.30 p.m.